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POPULAR ZOOLOGY

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CHAUTAUQUA EDITION

A
POPULAR ZOOLOGY

BY

J. DORMAN STEELE, PH.D.
AUTHOR OF A SERIES IN THE NATURAL SCIENCES

AND

J. W. P. JENKS, A. M.
PROFESSOR OF AGRICULTURAL ZOOLOGY IN BROWN UNIVERSITY

> *"And Nature, the old nurse, took*
> *The child upon her knee,*
> *Saying, 'Here is a story-book*
> *Thy Father hath written for thee.'"*
> *Longfellow's "Tribute to Agassiz."*

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IN
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BY

J. DORMAN STEELE, PH.D., F.G.S.,
Author of the Fourteen Weeks Series in Natural Science, etc., etc.

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PREFACE

This work is prepared upon the same general plan as the preceding books of Dr. Steele. Among the principal features are: Brevity; directness of statement; such a presentation of the subject as will lead the pupil to love the study; frequent foot-notes, containing anecdotes, curious facts, explanations, etc.; a uniform system of analysis in bold paragraph titles; and a gradual introduction of scientific terms and language, so as to fit the scholar to read zoological literature.

Believing that a description of a new animal is assisted by using a wood-cut, the authors have aimed to give a figure of each one mentioned; accompanying it, where necessary, with minor illustrations of functional peculiarities. In order not to discourage the beginner with dry and dull anatomical details, the text is largely occupied with biography, telling "how animals act, think, and are mutually related"; for a fact concerning the adaptation, habits, etc., is as valuable and far more interesting to students, than one about some unpronounceable bone or muscle.

To lead, however, to closer observation, characteristic physiological distinctions introduce, in general, each Branch, Class, and Order. A section is also given on Comparative Anatomy, and numerous cuts of skeletons will enable any teacher familiar with the subject to continue it as desired.

The limits of the book compelled a selection to be made from the numberless animal forms. Every class, however, is named, with most of its orders and many of the principal genera, each one illustrated by a cut and description of a typical species. Tables for classification of the Vertebrates precede, in general, every division. These will enable the pupil to refer any animal to its order, and, in many instances, to its genus; though it should be borne in mind that the characteristics given are applicable to the genera and species described in the text, and not necessarily to all belonging to the order. In addition to these analyses, a tabular view of all the animals treated is inserted in the Appendix.

It has not seemed best to define each term in the text, but the Index is very full, and contains the explanation, definition, and reference of every ordinary zoological word used in the book. As far as possible, each scientific name is followed, in parenthesis, by its pronunciation. To guide in pronouncing the titles of the cuts, the quantity of the penult and the position of the accent are carefully given.

Ample directions to the beginner for collecting and preserving specimens are given in the Appendix. These, with the hints in the foot-notes, will enable the pupil to undertake the study of Nature understandingly.

The present edition of "Fourteen Weeks in Zoology," not only revised, but largely rewritten and entirely reversed in its arrangement, though retaining those salient features that have given the work such popularity for ten years, appears under the joint authorship of Professors Steele and Jenks, the latter being alone responsible for accuracy of statement and the general plan of treatment of the subject. The entire manuscript was read to Dr. Steele, the week before his decease, and amended by most valuable suggestions from him both as to the matter and the phraseology; and the last literary work of his life was that of writing a long letter to the Publishers, approving the new arrangement and detailing his ideas in respect to the typographical execution. Hence the work, as now presented to those in our High Schools and Academies who are beginners in the study of animal life, is hardly a posthumous book on the part of the deceased lamented author, as it goes forth on its errand, stamped with his living approbation.

Many of the cuts were taken from nature; the others were selected from the works of Owen, Carpenter, Wood, Milne-Edwards, Jones, Woodward, Claus and Sedgwick, the Pictorial Museum, etc.

SUGGESTIONS To Teachers

THE Tables are not, at first, to be committed to memory, but only read to give a general view of the subject, and afterward learned by a constant reference to them as each class, order, etc., is taken up. Thus, the table on page XIII should be in constant use during the term, and the last part would not be fully understood until the book is finished. The text contains nothing which the cut can better exhibit; hence the figure should be studied carefully. The teacher is advised to require his pupils to draw on the board an outline of each animal, showing its size as obtained from the scale under the cut, and every peculiarity in the structure of its teeth, claws, hoofs, bill, etc. This should be followed by a familiar description, drawn from the cut, the text, the teacher's instructions, and every other source of information—above all, the creature itself, where it can be secured. (See note, p. 127.)

Pupils should be encouraged to make original researches. They can prepare (see page 283) the skeleton of a cat, dog, or other small animal. They can secure common birds, squirrels, frogs, snakes, and insects; and a little practice will often develop a taste for curing and mounting, which will be as instructive as delightful. They can make collections of birds' eggs and nests. Even the careful study of a common fowl or an oyster, a bird building its nest, an ox chewing its cud, a spider spinning its web, a cat catching a mouse, the varied paces of a horse, or the metamorphosis of a caterpillar, will give a fresh zest to the work. If any opportunity offers, the class should visit a menagerie, book in hand, name the animals, and verify the statements of the text.

The knowledge of the teacher should be sufficient to fill out and supplement the brief descriptions of a text-book. The following works will furnish additional facts, and aid in further investigations. Pupils may often be persuaded to procure copies as a foundation for their library: Packard's "Guide to the Study of Insects," and his "Zoology"; Dana's "Corals and Coral Islands"; "The Standard Natural History"; Coues' "Key to North American Birds"; Baird, Brewer, and Ridgway's "North American Birds"; Emerton's "Life on the Sea-shore"; Carpenter's "Comparative Physiology"; Jordan's "Vertebrates of North America"; Claus and Sedgwick's "Zoology." The back volumes of the "American Naturalist," "Science," "Popular Science Monthly," and "Harper's Magazine" (see Natural History in the Index volume), contain numerous excellent articles, many of them finely illustrated. The above-named books, as well as a microscope, so essential to efficient instruction, can be obtained of the publishers of this work, Messrs. A. S. Barnes & Co., 111 and 113 William St., New York. Specimens of all the typical species of animals, as well as many beautiful casts, are constantly kept for sale by Prof. Henry A. Ward, Rochester, N. Y. Skins for study of either birds or mammals, or handsomely mounted cabinet specimens, also material for laboratory work as well as dissecting instruments, can be obtained of J. M. Southwick, Providence, R. I.

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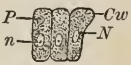
INTRODUCTION.

IN examining different objects and substances, we instinctively distinguish between inorganic and organic matter. Organic matter presents us with material which has, or once had life, and is of a definite structure. It is made up of one or many units, so-called *cells*, each of which, though generally of small size, bears the same relation to an organism that a tile might bear to a building. On examining several cells from different organisms, as we might examine the tiles from different houses, we find that they resemble one another, in that each is composed of a nutritive material, the *protoplasm* (prō′tō plăzm), which may be inclosed by a thin *cell-wall*, and may contain an area, the *nucleus* (nū′kle us), which in turn may present one or more foci, the *nucleoli* (nū klē′ō lī). An isolated cell, absorbing food, may grow and subdivide, each subdivision again subdividing, until a complex organism, or broad patches, called tissues, are formed.

FIG. 1.



Group of Cells. *Cw*, Cell-wall. *N*, Nucleus. *n*, Nu clē′o lus. *P*, Protoplasm. (Greatly enlarged.)

Organisms are naturally divided into two *kingdoms*—the vegetable and the animal—the lower forms of each of which so resemble one another as almost to defy distinction.

The study of animals, **Zoology** (zo ŏl′o jĭ) [*zō′ŏn*, animal; *lŏg′ŏs*, a discourse], would naturally begin with the more simple forms, and finally conclude with those of the highest development. We would not, however, were we even to include a consideration of all fossilized, as well as living, forms, meet with an unbroken series; but would find rather a branched arrangement, the ultimate twigs of which might represent the living forms. It is the province of systematic zoology to discover the relations that these ultimate twigs bear to one another and to their supporting branches, giving us finally a natural arrangement, a complete *classification.*

Classification. — The systematic zoologist first deals simply with individuals; finding several which bear a strong resemblance to one another, but nevertheless have some little points of variation. The few he picks out may be the swallows, and he gives to them a characteristic generic name, *Hirundo* (hī rŭn′do), and characterizes each peculiar form under this genus, by some specific adjective, as *horreorum* (hor re ō′rum), "of the granaries," for the Barn Swallow, and *Hirundo bicolor* (bī kŭl′or) for the Two-colored Swallow.*

Several birds may be swallow-like but not true swallows; these would be given different generic and specific names, but would be included in the *family* of swallows, the **Hirundinidæ** (hī run dĭn′ĭ dē).

Several families, as the swallows, sparrows, robins, etc., may show structural peculiarities which unite them into an order, the **PASSERES** (păs′sĕ rēz).

Several orders, however, resemble one another in many important structural and anatomical peculiarities and are united into a single *class*, **AVES** (ā′vēz), which includes all the birds.

---

* This, giving to each animal a Latin or Latinized generic and specific name, is called the binomial (*bī nō′ mi al*) system of nomenclature (*nō men klāt′ ūr*), and is that adopted by naturalists throughout the world.

The birds are united with other classes, as the fishes, reptiles, mammals, etc., in being built on the same general plan, and are regarded as off-shoots of a single *branch*, the VERTEBRATA (vẽr te brā′tȧ). Several branches, as vertebrates, arthropods (är′thrŏ pŏdz), etc., spring from the main *trunk*, or ANIMAL KINGDOM. As will be seen further on, an effort has been made to have these scientific terms characteristic.

A general arrangement of the Animal Kingdom would be tabulated as follows:

				BRANCHES.
SINGLE CELLED ANIMALS…………				*Prō to zō′ ȧ.*
MANY CELLED ANIMALS.	Exhibiting a Rā′di āte structure.		With several incurrent and one, or several, excurrent openings.	*Po rĭf′ ĕ rȧ.*
			With a single incurrent, which serves also as an excurrent opening.	*Cœ len ter ā′ tȧ.*
			With a single incurrent and also a single excurrent opening.	*Ech i no dẽrm′ ă tȧ*
	Exhibiting a more or less obvious segmented structure.	WITHOUT JOINTED LOCOMOTORY APPENDAGES.	Not covered by a "mantle."	*Vẽr′ mes.*
			Covered by a "mantle."	*Mŏl lŭs′ cȧ.*
		WITH MORE OR LESS JOINTED LOCOMOTORY APPENDAGES.	Skeleton external.	*Är thrŏp′ o dȧ.*
			Skeleton internal.	*Vẽr te brā′ tȧ.*

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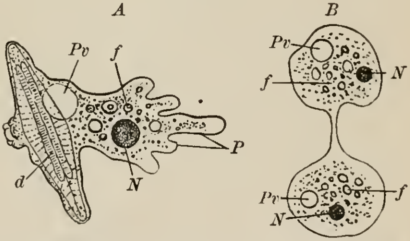
I. THE INVERTEBRATES.*

BRANCH PROTOZOA (prō to zō′ȧ).

SINGLE-CELLED ANIMALS.

This, the introductory Branch, includes those animals which have the simplest structure. The Protozoans are minute forms, seldom equaling a pin's head in size, and are generally found only in salt and fresh water. Their bodies are soft and jelly-like, each containing one or more *nuclei*, and often presenting a granular mass of food, which has been taken into the central portion of the body. When examined with a microscope of considerable power, there is seen to be a small portion, containing a fluid, which is repeatedly sent out in divergent rays through the body substance, or *protoplasm*. This portion is called the *pulsating vacuole* (văk′ū ōl), and serves to force the nutritive products of digestion over the body.

FIG. 2.



A mœ′ba prō′tē us. *A*, Individual that has surrounded a Diatom † (*d*) from which it is drawing nourishment. *Pv*, Pulsating or Contractile Vacuole. *N*, Nucleus. *f*, Particles of Food. *P*, Pseudopodia. (Greatly enlarged.) *B*, An Individual subdividing. The lower part becoming separate from the upper, was observed to again subdivide. (Greatly enlarged.)

---

* The term "Invertebrates" will become obvious further on in the study, when contrasted with the term "Vertebrates."

† A Diatom (*dī′ă tŏm*) is one of the lower plants.

CLASS RHIZOPODA (rī zŏp′ŏ dȧ).

The members of this class are often little more than animated drops of jelly-like protoplasm, which move about by simply thrusting forth a small portion from any part of their body, into which the remaining portion slowly rolls. On meeting with a suitable piece of food, this is taken into the body, by the animal's rolling itself around and over it.

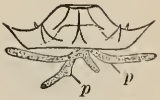
In many forms, there is deposited around this jelly-like body, a perforated shell, through the holes, or *foramina* (fo răm′ĭ nȧ), of which, projections of the body can be thrust to seize and digest food outside of the covering. Protozoans which are capable of thus thrusting portions of retractile protoplasm from their bodies are called Rhizopods (rĭz′ọ pŏdz), as these extended foot-like portions, *pseudopodia* (sū do pō′di ȧ), often have the branched appearance of roots.

ORDER FORAMINIFERA (fo răm i nĭf′ĕ rȧ).

The members of this order may, or may not, be protected by a porous shell. Of the latter kind, the **Amœba** (a mē′bȧ) inhabits nearly every small body of fresh water, and is often found in great numbers. When observed under the microscope, it is seen to move about and secure its food by thrusting out pseudopodia. One or more contractile vesicles (vĕs′ĭ klz) and nuclei are generally present, and the more central area is colored by the presence of food granules (grăn′ūlz). Two Amœbæ, while slowly rolling about, may meet and devour each other, and a single animal may voluntarily subdivide and form two individuals. Indeed, this *self-fission* (fĭsh′ŭn), as it is called, is the ordinary method whereby the Amœbæ are multiplied.*

Figure 3 represents an Amœba-like Rhizopod, which is found in great abundance in mossy pools. It will be observed to have a regularly formed shell, or covering, into which it is able to withdraw.

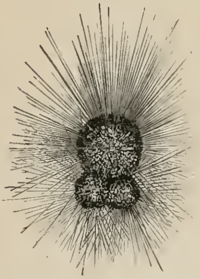
FIG. 3.



Ar cĕl′la den tā′ta. Crown Amœba. Projecting from the shell are several Pseudopodia (*p*). (Greatly enlarged.)

The Foraminifera proper are marine, being found in great abundance on the high seas, where their dead shells fall to the bottom in a continual shower and form there, in time, a deposit of great thickness, which, as it hardens, becomes limestone. Thus, though each one is almost infinitely small, these animals, working from earliest ages, have been active agents in molding and modifying the geological formation of the globe.†

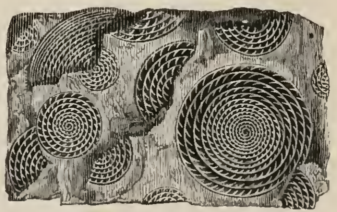
FIG. 4.



Glŏb ĭg er ī′na bul loi′des. (Greatly enlarged.)

Globigerina (glŏb ĭj er ī′nȧ) is the most abundant form, its dead shells characterizing the ooze that covers the ocean depths. On quiet evenings, the live animals may be skimmed from the surface of the water, though it is quite difficult to secure specimens which have not been mutilated, as the long *calcareous* (kal kā′rĕ us) spines are very brittle.

FIG. 5.



Num mu lī′tes a tā′ĭ ca. Rhizopod.

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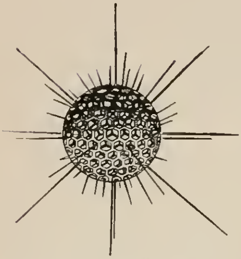
* When the surroundings of the animal are unfavorable for reproduction by *fission*, budding may take place. In this case, the new Rhizopod, in some species, remains attached to the shell of the parent, giving rise to the forms known as Nummulites, etc.

† Foraminifers (*fo ra mĭn′ĭ fers*) have furnished in large part the extensive chalk-cliffs of England, and much of the architectural material of the world, as well as that of the marl-beds, so abundant on the Atlantic coast of the United States.

ORDER RADIOLARIA (rā di o lā′rĭ ȧ).

FIG. 6.



Hē lĭ o sphæ′ ra ē chīn oid′ es. Spiny Radiolarian. (Greatly enlarged.)

The **Radiolarians** are characterized by the possession of a *silicious* (sĭ lĭ′-shus), not calcareous, armor from which often project a multitude of long diverging spines. No pulsating vacuole has as yet been discovered, though the body is much more granular than in the previous order. The pseudopodia are capable of being extended to a great distance, often forming a delicate net-work outside the shell,* and variously used.

CLASS INFUSORIA (ĭn fū sō′rĭ ȧ).

We now come to those Protozoans which, unlike the Rhizopods, have an elastic covering for the body, provided with one or many whip-like prolongations. These prolongations incessantly lash the water, as organs of locomotion, or whip the food into an opening in the covering, or sac. From this opening, the food passes to the central portion of the body. One or more nuclei and a contractile vacuole are invariably present. Many of the forms possess, also, a thin membranous covering, or *cuticle* (kū′tĭ kl).

INFUSORIA make their appearance in vessels of water, either salt or fresh, which contain decomposing animal or vegetable matter. From their abundance in these infusions they derive their name.

---

* These animals are found in large numbers on the surface of the ocean, and their dead shells, like those of the Foraminifera, are not infrequently found in the solid rocks of the land, showing conclusively that such rocks were once covered by the ocean.

ORDER FLAGELLATA (fla jĕl′ lă tȧ).

Flagellate (flă′jĕl lāt) **Infusorians** are peculiar in that they seldom possess more than one or two *flagella*, or lashes. They are extremely minute and resemble in various respects the lower plants. They are, indeed, considered by many zoologists as the property of botanists. They are distinct, however, in that their motions seem to be more definite than those of flagellate plants, in possessing a contractile vacuole and in using the flagellum to force bits of solid food into a small opening at its base, which answers for a mouth.

FIG. 7.

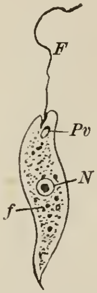


FIG. 7.—*Eu glē′na vĭr′i dis.* Green Euglena. *F*, Flagellum at base of which is an opening through which food (*f*) may be forced into the body substance. *Pv*, Pulsating vacuole. *N*, Nucleus. (Greatly enlarged.)

FIG. 8.

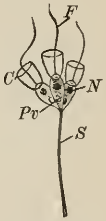


FIG. 8.—*Co dŏs′ĭ ga bo trȳ′ tes.* Clustered Codosiga. *S*, Supporting stem. *Pv*, Pulsating vesicle or contractile vacuole. *N*, Nucleus. *C*, "Collar." *F*. Flagellum. (Greatly enlarged.)

The *Green Euglena* (ū glē′nȧ) often appears on the surface of stagnant pools, forming a green scum. Under the microscope it is seen to move rapidly about by lashing with its flagellum.

Codosiga (ko dŏs′ĭ ḡȧ) is a minute form found in colonies* attached to the stems of fresh-water plants. It is peculiar in having the flagellum surrounded by a collar.

The *Noctiluca* (nŏk tĭ lū′kȧ) is of interest, in that it has the power of producing a phosphorescent light. During quiet evenings of the summer months, millions of these animals rise to the surface of the ocean, lighting the waves for miles in extent, with a most beautiful golden sheen. This is not the only form, however, which can lighten up the sea; many other Protozoans, as well as certain individuals of every other branch, have a like power.

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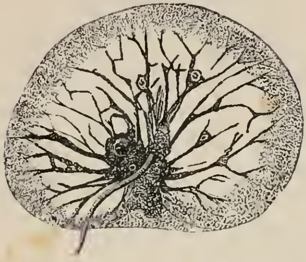
* Many of the flagellate forms are found collected in colonies. Each colony presents either a tree-like or a spherical structure, new forms taking their places in the old group.

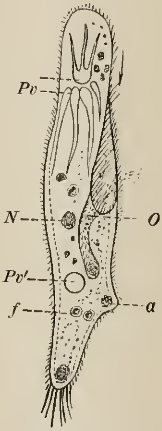
FIG. 9.



Noc ti lū′ ca mil i ā′ ris. (Magnified.)

The Noctiluca not only multiplies by fission, but may draw in its flagellum, lose its mouth and become a mere sphere of protoplasm, a *cyst* (sĭst). After resting encysted for some time, the cyst breaks open and a multitude of minute Noctilucæ hasten forth. This phenomenon, which has also been observed in some Rhizopods, is called "multiplication by the formation of zoospores" (zō′o ṡpōrz).

FIG. 10.



Par a mœ′cĭ um cau dā′tum. The arrows indicate the direction of the current induced by the action of the cilia. *O*, The course the food takes on entering the body substance. *a*, Matter no longer containing nutriment being thrust from the body. *f*, Food mass. *N*, Nucleus. *Pv′*, Pulsating vesicle immediately before and *Pv*, immediately after contraction. (Greatly enlarged.)

ORDER CILIATA (sĭl i ā′tȧ).

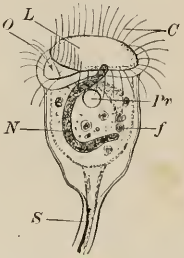
The **Ciliate Infusoria** have not the long flagella of the previous order, but are very generally provided with numerous small cilia which serve as organs of locomotion; though, around an opening, which answers for a mouth, the cilia may be of larger size and of use in securing and retaining food.

The *Paramœcium* (par a mē′sĭ um), is a very common form, found in stale water, while often attached to the stems of aquatic plants are colonies of

Bell Animalcules (ăn i măl′kūlz). When viewed under a microscope each single bell is found to have a ciliated lid with a mouth-opening* under one portion of its circumference. In the body can often be seen an elongated nucleus and one or two pulsating vacuoles. On being irritated, the stems of the small bells contract, bringing the entire colony against the object to which it is attached.

During the warm weather, when the pools dry up, these ciliated animals draw in their cilia and enter an encysted stage; a few days of moisture, however, will serve to burst the wall of the cyst, when a multitude of new Vorticellæ swim forth.

Fig. 11.



Vor ti cĕl′ lȧ neb u lĭf′ ĕ rȧ, or Bell-animalcule. *C*, Row of long Cilia encircling the disk or lid, *L*. *S*, Stem. Other letters same as in previous figures. Note the elongated nucleus. (Greatly enlarged.)

While considering the members of this first Branch of the animal kingdom, though dealing with animals consisting of but a single cell, we have found them capable of motion, of sensation, of finding, securing, digesting, and assimilating food, and of reproducing other animals similar to themselves. Thus, in their humble position, they are endowed with powers resembling, though not equaling, those of the higher forms.

All other animals are made up of aggregations of cells, and are thus of such a size as to be generally appreciable to the unaided eye. This many-celled structure of the remaining Branches has given to them the name of *Metazoa* (mĕt a zō′ȧ).

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* In many parasitic ciliata, as in the parasites of the higher animals, the mouth parts are wanting, and the animal receives its nutriment by imbibition,—no solid food being taken.

BRANCH PORIFERA (pō rĭf′ĕ rȧ).

THE SPONGES.

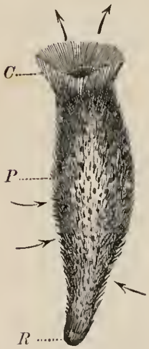
SPONGES during life are quite different from the mere sponge-skeleton which is the article of commerce. They are more or less gelatinous (je lăt′i nŭs) masses, found mostly in salt-water, and are supported by a framework which may be either calcareous, silicious, or horny. The forms of sponges are of great variety.

CLASS SPONGIA (spŭn′jĭ ȧ).

ORDER CALCISPONGIA (kăl sĭ spŭn′jĭ ȧ).

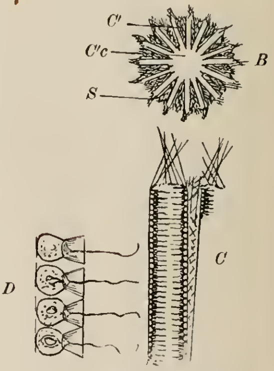
A Calcareous Sponge, *Grantia* (grăn′tĭ ȧ), of about half an inch in height, well illustrates the anatomy of the Branch. Water is induced to enter, through external pores (Fig. 12), to small *radiate* chambers which are lined with collared flagellate cells. These flagella not only whip along the water, but, like Codosigas, seize upon all nutritive matter which the water con-

FIG. 12.



Grăn′tĭ a cil i ā′ta. A Calcareous Sponge. *C*, Crown of spines around excurrent opening. *P*, Pores admitting water, as indicated by arrows. *R*, Root-like base. (About twice the natural size.)

FIG. 13.



Internal Anatomy of Grantia. *B*, Cross-section, diagrammatic, showing that the "pores" lead into converging tubes (*C′*) which open internally into a central cavity (*C′c*). *S*, Spicules arranged as strainers over "pores." *C*, More enlarged view of "tube," showing it to be lined with *Codosiga*-like cells. *D*, A few of the cells highly magnified.

tains. We can think of the sponge, then, as a colony* of protozoan animals, each living a separate life, though interested in the welfare of its neighbors. The water, after having been examined by these flagellate cells, passes on into a central cavity, and finally leaves the sponge through a large opening at the apex.

Often attached to the side of this more simple sponge are so-called "*buds*," which are young sponges in process of growth.

ORDER HYALOSPONGIA (hī al o spŭn′jĭ ȧ).

Silicious, or Glass Sponges, are less common.†

ORDER CERAOSPONGIA (sē rā o spŭn′jĭ ȧ).

Sponges having a horny skeleton are those with which we are most familiar. If a common bath sponge, *Euspongia adriatica* (ū spŭn′jĭ ȧ ad ri ăt′ĭ kȧ), be examined, there will be found small pores, leading in at the sides, while at the apex are the large excurrent openings. Those who cure the sponge, wash away the soft flagellate cells together with other slimy portions of the animal's body. All the more valuable forms are found in the warmer regions.

We have thus seen that the Porifera are animals whose bodies consist of numerous cells, supported by a framework, or *skeleton*. Until recently, the members of this Branch were considered by many naturalists as plants; but the working out of their life-history has proved them entitled to higher rank than some other animals.

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* "It is a kind of sub-aqueous city, where the people are arranged about the streets and roads in such a way that each can choose his food from the water as it passes along."—HUXLEY.

† The most beautiful is the *Euplectella aspergillum* (ū plĕk′tel la ăs per gĭl′lum), in which the silicious fibers form a delicate mesh of lace, known as Venus' Flower Basket, formerly considered a unique specimen of Chinese industry.

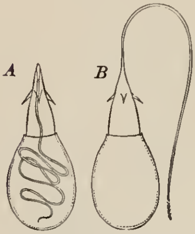
BRANCH CŒLENTERATA (sē len ter ā′tȧ).

THE CORALS (kŏr′ălz), ETC.

We now meet, for the first time, with animals provided with a true mouth; with a skin formed by layers of interlocking cells; and with arms, or tentacles, for thrusting captured food through the mouth and into a central bag, which answers for a stomach. This "*stomach*" is of such a rudimentary nature that it has given the name (hidden intestine) to the Branch.

The exterior of the body of CŒLENTERATES (sē lĕnt′ĕr ātz) is beset with a countless multitude of cells, *lasso-cells*, which are capable of throwing out, with considerable force, long threads, the fine poisoned ends of which enter the skin of such animals as may be passing by, producing a paralysis and rendering their capture easy.

FIG. 14.



Lasso-cells. *A*, The cells with its "lasso" partly shot forth. *B*, The same completely extended.

These animals are all aquatic: many are of considerable size, and others, the Corals, though often small as individuals, have been active agents in changing the outlines of coasts and in forming islands.

CLASS HYDROZOA (hī drō zō′ȧ).

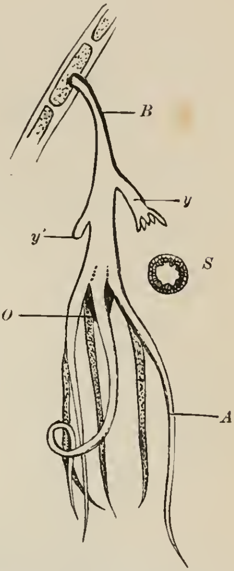
The common *Hydra* of every fresh-water pool and slowly running stream, introduces us to the HYDROZOA.

ORDER HYDROIDEA (hī droid′ĕ ȧ).

The *Hydra* is about one fourth of an inch in length, and is often of a deep green, or brown color. By reference to the figure, or, better still, to the live animal, we notice that it resembles the simple sponge in having an elongated body, at the apex of which is an opening. The radiate plan is here shown in the disposition of the long arms, or *tentacles* (tĕn′ta klz), which surround the mouth-opening. Other sponge-like characters are the possession of a central cavity and often the presence of small buds attached to the side of the parent. A further study, however, will reveal many things in the Hydra quite different from the Sponge.

There are no canals piercing the sides of the animal, hence the food must enter in another way. If we watch a Hydra which has become attached to the side of a glass jar, containing green slime and stagnant water from some pool, we notice that the small forms of animal life swimming around often become inactive on approaching the Hydra, being stung by the lasso-cells, and are seized in the animal's tentacles and thrust into the terminal opening, or mouth. The food, much larger than that capable of being captured by the flagellate cells of the sponge, passing through the mouth, simply enters the bag-like *body cavity*, where it is acted upon by the digestive fluids; the hard, innutritious portions being finally expelled through the same opening by which they entered. Leading from the body

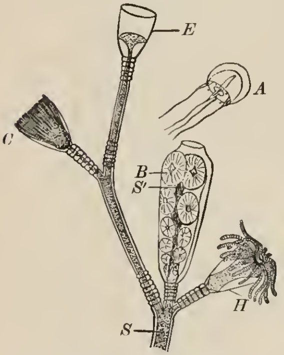
FIG. 15.



Hȳ drȧ fŭs′-eȧ hanging from an aquatic plant. *B*, Lower portion of body. *O*, Position of mouth. *A*, One of the arms. *y*, A "bud" partly expanded. *y′*, A "bud" contracted. *S*, Cross-section through body showing disposition of two cell layers around the central cavity. (Enlarged about five times.)

cavity are the cavities of the tentacles, which are simple outpushings of the body wall, being given their form by the nutritive fluid they contain. If this liquid is withdrawn, the tentacle sinks down to a mere elevation. On being irritated, the Hydra may allow most of the liquid to escape from its body, contracting itself into a small knob. It is thus without the supporting skeleton of the sponge.

FIG. 16.



O bē′lĭ a ge lăt ĭ nō′sa.
S, Supporting stem. *E*, Cup. *C*, Contracted individual. *H*, Expanded individual showing its mouth at the center. *S′*, Support bearing Buds (*B*), which eventually leave the surrounding cup and swim away as *A*, the Medū′sa of an allied form. (Enlarged.)

The **Campanularian Hydroid** (kam pan ū lā′rĭ an hȳ′droid), *Obelia gelatinosa* (ō bē′lĭ a je lăt ĭ nō′sā), is another representative of this class. It looks like a Hydra surrounded by a cup, into which, on contracting, it can withdraw. The cup may be supported at the tip of a long branching stock, the base of which is attached by root-like expansions to some support, as the side of a spile or the frond of a sea-weed.

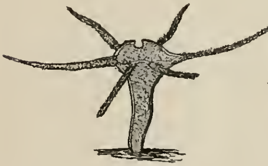
When these branching animals are examined during the summer months, some of the cups, or bells, are found to be without mouth or tentacles, and to have in place of the body, a central stock from which "buds" are growing. These buds finally break from their support and swim away. This free form, of minute size, is called a *Medusa* (me dū′sȧ), is bell-shaped, and swims by alternately expanding and contracting its rim. Around the edge, are several small sacs, connected together by a nervous cord and filled with liquid, in which are small, hard particles. When the water is disturbed, these impinge upon the nervous walls of the sac, giving to the animal the sensation of sound. Here, then, we meet for the first time with organs of hearing and with a connected nervous system.

As the Medusa slowly propels itself through the water, stretching out behind is a series of long streamers armed with lasso-cells and of use to the animal in procuring its food and in directing its course. These free Medusas carry with them eggs, which, finally, on becoming attached to some support, develop into branchial Campanularian Hydroids.*

ORDER DISCOPHORA (dis kŏf′ŏ rȧ).

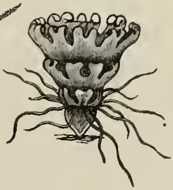
The life-history of the **Jelly-fish** well illustrates another group of the Hydrozoa.

FIG. 17.



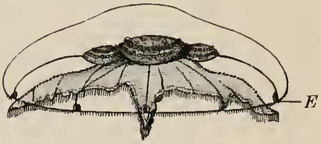
Hydra-like stage.

FIG. 18.



Later stage of Fig. 17.

FIG. 19.



Free-swimming Jelly-fish. *E*, Eye-spot.

The several stages in the development of the Jelly-fish, *Au rē′lī a fla vi dū′la.*

The egg, on becoming attached, finally develops into a form much resembling the Hydra. The portion of the body above the tentacles, however, continues to grow until it is enormous. Constrictions soon appear and divide it transversely into a series of "saucers," of which the upper and largest breaks away from those below it, turns over and swims away as did the Medusa of the

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* It is a singular fact that through a lack of food, certain Medusæ have been known to return finally to their attached hydroid condition.

Campanularian. Finally, all the saucers thus swim away and, rapidly growing, become Jelly-fish.*

CLASS ACTINOZOA (ăk tĭ no zō′ȧ).

Some of the members of this class are remarkably like the Hydra; a circle of tentacles, disposed radially around the mouth, being supported upon a cylindrical body.

Actinozoa, however, are exclusively salt-water animals; are of comparatively large size; and have the mouth not opening directly into the body-cavity, but leading through an *œsophagus* (ē sŏf′a ḡŭs) into a bag-like stomach, which is open below and allows the nutritive products of digestion to pass into the body cavity. The œsophagus and stomach, moreover, are held in position by a radial series of fleshy partitions, the *mesenterial folds*, attached at their peripheries (pe rĭf′er ĭz) to the body wall. This body wall, though tough, is soft and flexible, and can be expanded with sea-water, which the animal, on being irritated, allows to escape through lateral pores and from the mouth, thus contracting itself to a mere knob. Often the body wall, as in previous forms, supports buds which in turn may support other buds, giving rise to branching forms. In such cases, the skin may be stiffened by the deposition of horny matter, or of lime, making a stem either tough and flexible, or hard and brittle.

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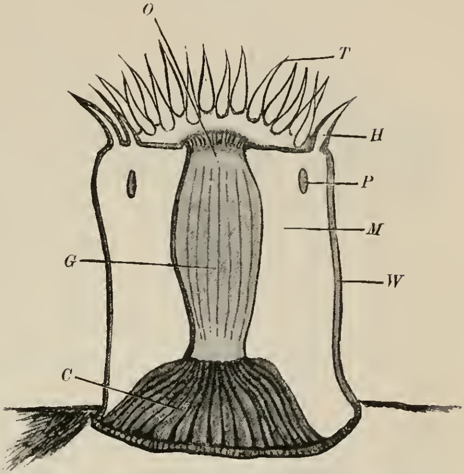
* Jelly-fish abound along the coast, and are to be seen by the thousands in calm weather during the summer months, appearing at night like specters moving about with their phosphorescent light. Though many are small, the size of a cup, others are as large as a tub, and their long streamers, armed with lasso-cells, cause no little annoyance to bathers. The bodies of Jelly-fish are loosely held together, and on being removed from the water, will often slip through the hand in strings. So much of the body is water, that, if allowed to remain in the sun's rays, after desiccation little more than a mere scale will be left.

ORDER ACTINOIDA (ăk tĭ noi′då).

The **Actinoida** are characterized by having the mesenterial folds and tentacles arranged on a plan of six, and by having the support, when present, of limy matter.

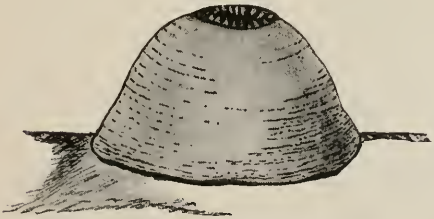
FIG. 20.



Diagrammatic view of an *Ac tin o zō′on*, Sea-anemone, one side being removed to show internal anatomy. *T*, Tentacles. *O*, Mouth leading into the œsophagus (*G*), which in turn opens below into the general body cavity (*C*). *M*, A Mesentery. The lower, free ends of others can be seen as radiating lines below the œsophagus. *P*, Opening in mesentery. *W*, Body wall. *H*, Section of tentacle showing that its cavity is continuous with the body cavity. (Natural size.)

The common *Sea-anemone* (a nĕm′o ne) is often found attached to the spiles of bridges or to the under side of overhanging rocks. When expanded, its gracefully waving, bright colored arms give the animal a plant-like appearance. To the small unwary fish, however, this beautiful growth is most dangerous to approach; for the slightest contact with one of its tentacles will cause the Anemone to throw out a multitude of poisoned barbs. These barbs quickly paralyze the animal which they pierce.

FIG. 21.



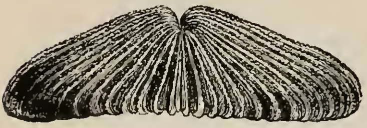
Me trĭd′ĭ um mar gin ā′tum.
Sea-anemone, as it appears when contracted.

The tentacles of the Sea-anemone are

smooth, hollow, and of a conical shape. They can be extended or withdrawn at will, and are of use to the animal as organs of touch. The number of tentacles is usually six, or some multiple of six.

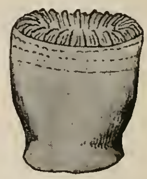
The simple *Mushroom* and *Cup Corals* are little more than Anemones. Between the mesenterial folds and at the base of the animal, there is a deposit of lime. Some species measure over a foot in diameter.

FIG. 22.



Cte năc′ tis e chi nā′ ta. Mushroom Coral.

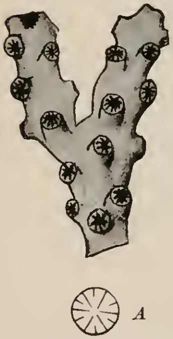
FIG. 23.



The co cy ă′ thus cy lĭn drā′ cĕ us. Cup Coral.

If we examine a branching coral, we shall find extending through the axis, the remains of a single elongated parent Actinia (ăk tĭn′ĭ ȧ), or *polyp* (pŏl′ ip), from which others branch out in every direction, all keeping a communication with one another through the axial canals, and also through the external fleshy investment. We thus see that the coral is deposited not as a result of the industry of the animals, but is merely, like our skeletons, a support. The reef-forming coral animals abound in tropical seas, while solitary corals are found at depths, even in the Arctic Ocean.*

FIG. 24.



Branching Coral. *A*, Plan of single animal.

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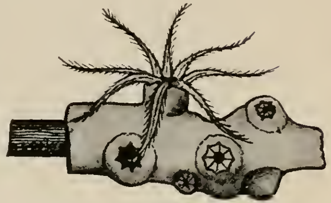
* Dana, in describing the coral reefs of the Pacific, says: "The Actiniæ may well be called the asters, carnations, and anemones of the submarine garden; the tubipores are literally its pink beds; the gorgoniæ, its flowering twigs; the madrepores, its plants and shrubbery. Astræas (star corals) often form domes amid the grove, embellished with green or purple blossoms; hemispheres of meandrina (brain coral) appear as if enveloped in a net-work of flowering vines; and vases of madrepores stand on a cylindrical base covered with branches, spreading gracefully from the center and decked with sprigs of tinted polyps.

ORDER ALCYONARIA (ăl sĭ o nā′rĭ ȧ).

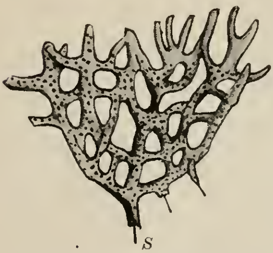
This order includes those Polyps which have the mesenterial folds and tentacles arranged on a plan of eight. The growth is supported on a horny or calcareous, often branching axis, surrounding which is a limy layer deposited in plates, allowing considerable flexibility. It is into the minute pores of this outer layer that the Polyps can contract.* The *Red Coral*, prized for jewelry, is the highly polished central axis of an alcyonarian Polyp, found growing, in small quantities, in the Mediterranean Sea. The *Sea-fan* is also a representative of this order. Its interlacing branches are covered with a purple or a yellow calcareous layer which, on drying, may cleave off, exposing the black *horny* axis.

FIG. 25.



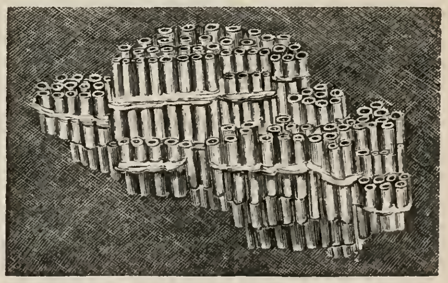
Co răl′lĭ um rū′brum. Red Coral. The hard central axis is seen projecting toward the left.

FIG. 26.



Gor gō′nĭ a fla bĕl′lum. Fragment of Sea-fan, showing the interlocking of the branches. *S*, The central horny axis.

FIG. 27.



Tu bĭp′ŏ ra mūs′ ĭ ca Organ-pipe Coral.

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* An aberrant form classed in this order is the *Organ-pipe Coral*, which consists of cylindrical tubes arranged like the pipes in a church organ. Each one is the cell of a single polyp, and the whole number in the mass is the progeny of the one that first became fixed at the base. Cross-plates at intervals preserve the unity of the mass. The mouth is located between the bases of the tentacles,

BRANCH ECHINODERMATA (ĕk ĭ no dĕrm′ă tȧ).

THE STAR-FISHES, ETC.

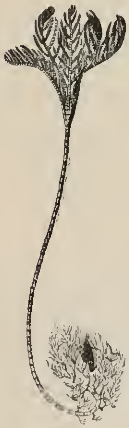
The ECHINODERMS (e kĭn′ŏ dĕrmz) present a radial structure, have the digestive tract without direct connection with the body cavity, have the skin indurated (ĭn′du rāt ed) by calcareous plates, and are generally free to move about. All are marine.

CLASS CRINOIDEA (krī noid′ĕ ȧ).

At early periods of the earth's history, the Crinoids (krī′noidz) abounded; now they are extremely rare, being seldom obtained except from deep water by dredging.

ORDER BRACHIATA (brā kĭ ā′tȧ).

Fig. 28.



Rhī zo crī′nus lof tĕn′sis.
The Norwegian Crinoid,
or Stone-lily.

The **Norwegian Crinoid** found in the North Atlantic at depths of 100 to 1,000 fathoms, is one of the smaller species. A long stem attached to the mud by root-like branches, supports a five-rayed animal, of the general appearance of a lily. As in the other metazoan animals thus far treated, the mouth is placed in the center of the disk from which the main rays diverge; but, unlike the Cœlenterates, a limy deposit prevents the quick contraction of any portion of the animal, and renders movement slow and limited. The food, moreover, which has been thrust down the œsophagus, has the nutritive portions absorbed by the walls of an *alimentary canal.* Along the upper surface of each arm, is a longitudinal groove from which project a multitude of small retractile tentacles, the *ambulacral appendages.* Other species of Crinoids finally break from the top of the stock and crawl away, free forms. These free Crinoids introduce us to the Star-fishes.

CLASS ASTEROIDEA (ăs ter oid′ĕ å).

The STAR-FISHES have the body much flattened and the ambulacral appendages, when present, provided with terminal suckers, of use in locomotion as well as in securing food. All are invariably free, *i. e.*, are not supported by a stock.

ORDER ASTERIDEA (ăs ter ĭd′ĕ å).

The common **Star-fish** is abundant along the sea-shore, where it commits great depredations on the oyster beds. Upon the lower side of each ray are several rows of ambulacral suckers, which may be thrust forth and become attached to foreign bodies; they are then contracted and the animal drawn up to the point of attachment, thus producing a slow locomotion. As the animal crawls, mouth downward, these suckers bring it over its food, which is thrust through the mouth into the stomach; or if the morsels are large, the stomach is everted, and the food digested outside the animal, the stomach being finally drawn back into the body. At the tip of each ray is a small red spot, the eye, which may give the animal the perception of light and shade. A small nerve can be traced from this spot, along the lower side of the arm to a nervous ring surrounding the mouth.* Recent

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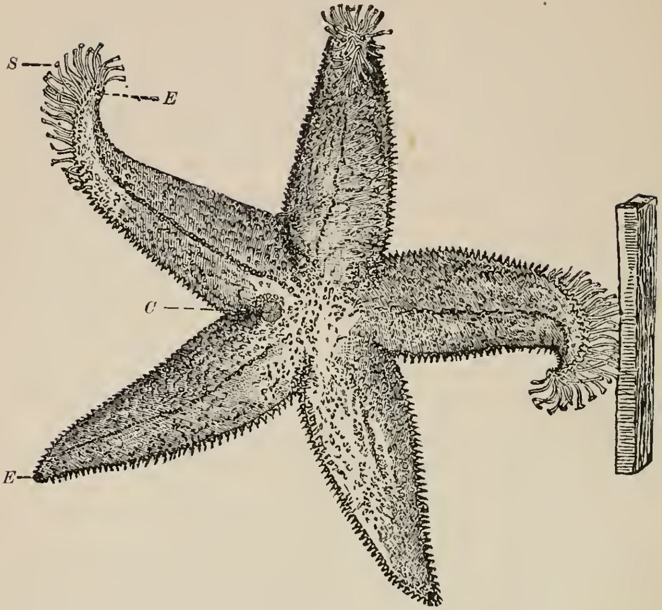
* As each arm contains special branches of all the necessary organs, the Star-fish can endure severe mutilation. Lost arms are replaced, and even single arms will live and finally develop into complete Stars. All the Star-fishes, of

FIG. 29.



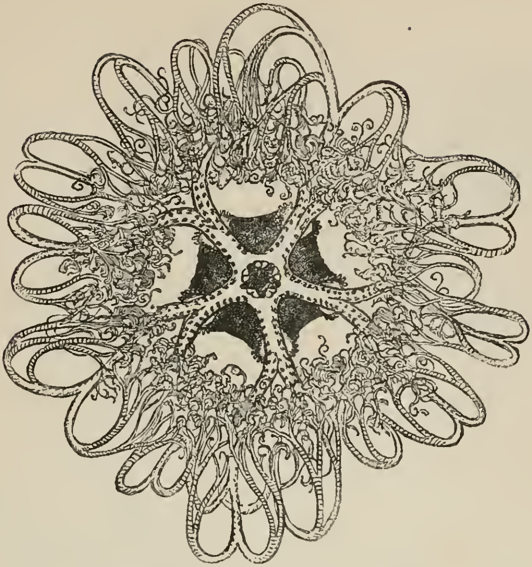
As tē′ rĭ as forbes′ ĭ ī. Star-fish. *E*, Eye-spot. *C*, Coral plate. *S*, Ambulacral suckers which on the arm toward the right are attached to a small stick.

experiments have also demonstrated the presence of a sense of smell. The water, which is taken in to expand the ambulacral suckers, or tentacles, enters through a brick-red sieve, the *coral-plate.*

The Pacific coast of North America furnishes several varieties of Star-fishes differing from *A. forbesii* in size, and also in the number of their arms,—some having six arms, while other allied genera have more than twenty arms and attain to the diameter of three feet and upward.

which there are at least one hundred and fifty species, have the power of disintegrating themselves, especially the many-branched varieties, and of restoring in a brief time the portions broken off. Hence, when fishermen vent their spite upon them for stealing their bait, by tearing them in pieces and throwing them overboard, they simply multiply the evil. Immersed in fresh cold water, they die instantly,

Fig. 30.



As trŏph′ y̆ ton a gas sĭs′ sĭ i. Basket-fish.

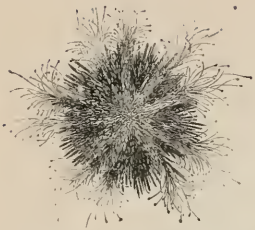
The *Basket-fish* represents species having the five rays subdivided till the number of ultimate branches is nearly five thousand.

CLASS ECHINOIDEA (ĕk ĭ noid′ ĕ ȧ).

ORDER CIDARIDEA (si dar ĭd′ ĕ ȧ)

The **Sea-urchins** differ from other Echinoderms, in having the calcareous plates so firmly united with each other, that all motion between them is precluded. The investing shell, thus formed, is perforated with numerous pores, through which ambulacral suckers can be thrust, enabling the animal to move about. Protective spines are invariably present,—in some species numbering more than a thousand.

FIG. 31.



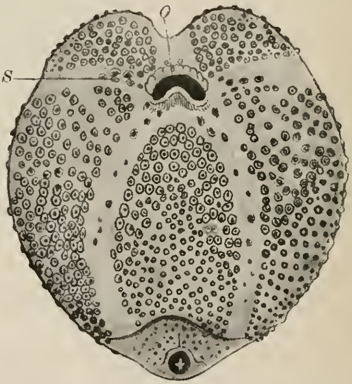
Stron gў̆ lo cĕn′ trŏ tus dro bachi ĕn′ sis. Sea-urchin, the ambulacral suckers appearing as the long filaments, far outreaching the protective spines.

The common *Urchin* of the North Atlantic coast is of about the size and shape, and has the general appearance of a chestnut bur. It moves about on the rocks, gathering vegetable incrustations from their surface by means of its five sharp teeth, organs with which we have not hitherto met. These are worked by thirty-five powerful muscles.

ORDER CLYPEASTRIDEA (klip ē as trĭd′ ĕ ȧ).

The **Sea-otter** departs somewhat from the five-rayed structure of the previous members of this branch. While an imaginary line might be drawn across the Star-fish, through the coral-plate and the arm which in Fig. 27 is toward the right, dividing the animal into two equal portions; the Sea-otter has a more obvious right side equaling a left side,—a structure characterized by the term "bilateral symmetry."

FIG. 32.



Schiz ăs′ ter. Sea-otter, viewed from the lower side. *O*, Mouth. *S*, Openings through which are thrust the ambulacral suckers.

CLASS HOLOTHUROIDEA (hŏl o thū roid′ ĕ ȧ).

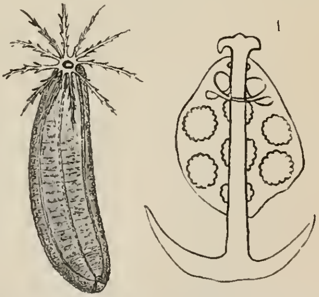
The HOLOTHURIANS (hŏl o thū′ rĭ anz), called *Sea-cucumbers* because of their peculiar form, are regarded as the highest of the Echinoderms. Though they depart considerably from the forms hitherto studied, they exhibit a five-rayed structure in the disposition of their tentacles and also of the rows of ambulacral suckers when these are present. The skin, which is tough and strong, contains numerous small calcareous plates.* The body is often elongated, worm-like, and presents a marked bilateral symmetry.

A good idea of the Holothurian can be obtained by conceiving a Sea-urchin to be drawn out from its attachment and then laid down on its side. Five, branched, retractile tentacles, which are of use in collecting small plants and animals, and forcing them into the mouth, take the place of the Urchin's teeth, while the hard shell and long spines have disappeared.

ORDER APODA (ăp′ŏ då).

Synapta (sĭn ăp′tå) is a form found along the Atlantic coast, and from its movements, is ordinarily mistaken for a worm. Its body is generally elongated and hidden away in subterranean passages in the mud. It feeds by swallowing sand in large quantities, leaving the digestive organs to gather from it what nutriment it may contain.†

FIG. 33.



Syn ăp′ta gi rărd′ĭ i. Girard's Sea-cucumber. A shortened individual. (Natural size.) *A*, The "anchor and plate." (Greatly magnified.)

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* These often take a definite form, as of "anchors," "wheels," etc.

† Holothurians have a most singular habit, when alarmed, of throwing out from their bodies portions of their alimentary tract. This may be a strange provision for their protection, since a preying fish would seize upon these softer morsels, leaving the tough skin, which finally replaces the lost parts. Synapta, possibly for a like purpose, often divides itself into numerous segments by violently contracting.

BRANCH VERMES (vĕr′mēz).

WORMS, ETC.

This branch includes animals presenting the most diverse peculiarities, and hence is difficult of precise definition. The body, however, is bilateral, and either entire, or divided into segments by transverse rings. Lateral appendages may be present, but are never jointed. Representatives are found on land, in water, both salt and fresh, and as parasites on members of nearly every branch of the Animal Kingdom. Though several classes have been defined, we shall consider only the more important.

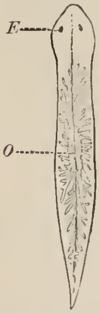
CLASS PLATYHELMINTHES (plăt ĭ el mĭn′thēz).

The so-called Flat Worms have the body depressed and more or less elongated. Some representatives are free; others are parasitic.

ORDER DENDROCŒLA (dĕn dro sē′lȧ).

The **Planarians** (plă nā′ri ȧnz) are the most common free Platyhelminthes, and are found in abundance gliding over the rocks of slowly running streams. If one of these animals be placed in a tumbler of water, its singular motions and peculiar structure can be observed. In the form most likely to be captured, there will be noticed a pair of dark dots, the eyes, on the anterior portion of the body, which is more or less diamond-shaped when the animal is stretched to its utmost. The mouth will be seen on the lower surface, placed far back and leading

Fig. 34.



Pla nā′rĭ a tōr′va.
Planarian Worm.
O, Mouth. *E*, Eye.

into a *branched* stomach. The peculiar gliding motion is the result of the combined action of invisible cilia.

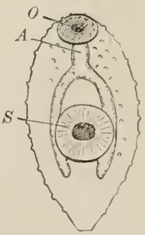
Though at first glance, the structure of this animal may appear quite new to us, by comparing it with the Anemone, we find several resemblances. If the latter animal be inverted, its tentacles retracted, and its body made capable of movement by being provided with cilia, we should have a very fair Planarian. The worm also shows cœlenterate features, in that it is armed with lasso-like cells, which it throws out on being irritated; and in sometimes multiplying by self-division. Though many Planarians of the warmer countries are terrestrial, all of our forms, with a single exception, are aquatic.

The remaining Flat Worms are mostly parasitic; that is, they attach themselves to some larger animal, their *host*, from which they draw their nourishment. When animals thus become parasitic, they are apt to lose, through disuse, many organs, which a free life would render quite necessary. Nature is thus found to be economical, never supporting useless organs.

ORDER TREMATODA (trĕm a tō′dȧ).

The **Liver Fluke,** nearly an inch in length, broad and flat, is one of the most common parasites. It is found in the bile-duct and other organs of herbivorous animals. Subsisting there on the fluid in which it floats, it has no need of eyes nor of special means of protection, hence these are not present. It is, however, provided with two suckers, ventrally placed, with which it holds to its host.

Fig. 35.



Dĭs′ tŏ ma he păt′ ĭ cum. Liver Fluke. *O*, Mouth, surrounded by a sucking disk. *A*, Alimentary tract. *S*, Ventral sucking disk. (Enlarged.)

The life history of this animal is of

particular interest. While still attached in one of the bile-ducts, it constantly sets free a multitude of eggs, which follow the duct to the intestine, from whence some finally reach damp earth or pools. There they hatch and give rise to active little eyed forms, which, on coming in contact with the soft parts of certain snails, thrust themselves through the skin and become encysted. After some time, one of these cysts may break open, as the snail crawls over the grass, and give birth to not one, but several active forms, each of which encysts on a blade of grass. A sheep, grazing, swallows the encysted animal, which the digestive juices bring into activity, and we finally have the completed cycle in the adult Fluke, which produces in sheep the disorder popularly known as "rot."

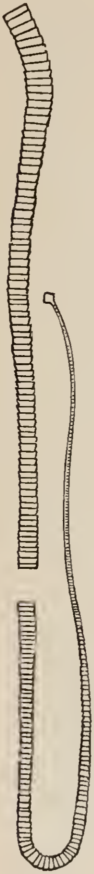


Fig. 36.

Tæ'nĭ a sō'lĭ um. Portion of Tape-worm of human being, including the small "head." The larger portion broken from the rest, may lead a separate life.

ORDER CESTODA (ses to'dȧ).

The **Tape-worms** also belong to this class. Several species of these worms are found in the intestines of various animals. Here we meet with a parasite, even more degraded than the Fluke. As the animal floats in the digested matter of the alimentary tract, it takes in its nourishment by absorption through the skin of its body. No mouth is present, though there is usually a number of hooks, and in some species, suckers, on the anterior portion of the body, the "head," by which it remains attached. Behind the head, and stretching back, in some forms for twelve feet, is the flat ribbon-like and jointed body, constantly elongating by the interposition of new joints next the "head." The older terminal joints are in the meantime falling off. Each of these can move about, and contains a multitude of eggs, which escape to the outer world. The omnivorous hog, perchance, devours some of these eggs; in its stomach, they hatch, and the young worms distribute themselves through their host, become encysted, and we have what is called "measly pork." These cysts, on opening in the alimentary tract of the animal which has eaten infected meat, give birth to small Tape-worms, which at once attach themselves to their new host.

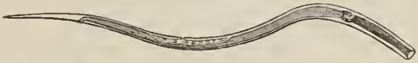
CLASS NEMATHELMINTHES (nĕm ăt el mĭn′thēz).

If cider vinegar be closely examined with a hand lens, it will be found to contain a myriad of small active worms, popularly called *Vinegar Eels*. A description of the anatomy of one of these will epitomize that of the class.

ORDER NEMATODA (nĕm a tō′dȧ).

The body of the *Vinegar Eel* is round and filiform (fĭl′ĭ fôrm); the alimentary canal extends as a tube, from the anteriorly placed mouth for nearly the entire length of the body; on each side, can often be distinguished a multitude of eggs. Though many members of this class live, like the Vinegar Eel, a free life, others are parasitic.

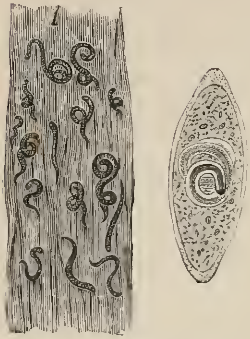
Fig. 37.



Lĕp tŏd′ĕ ra ŏx ŏph′ĭ la. Vinegar Eel. (Greatly magnified.)

The **Trichina** (trĭ kī′nȧ) is by far the most dreaded of human parasites. By eating raw or poorly cooked pork, as is often done with ham and Bologna sausage, encysted worms are taken into the alimentary tract, where the digestive fluids break the cysts, and free the animals, which deposit a multitude of eggs. These eggs soon hatch, and the young Trichinæ work their way through the tissues and migrate to nearly every part of the body; but finally settle down and become encysted in the muscles, in capsules about $\frac{1}{40}$ of an inch long, where they remain indefinitely. If the host can endure the irritation produced by this migration, fatal results will not follow.

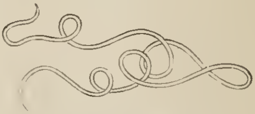
FIG. 38.



Tri chī′ na spi rā′ lis.
Migrating in muscles. Encysted.
(Greatly magnified.)

The **Hair-worms,** which are found in damp soil and in stagnant water, are forms closely allied to the Trichina. The *Gordius* (gôr′dĭ ŭs) often resembles a long hair from a horse's mane, and being found in the water, is considered by the ignorant to be an animated hair, which will finally develop into an eel. The young of Hair-worms are often found parasitic in small aquatic animals.

FIG. 39.

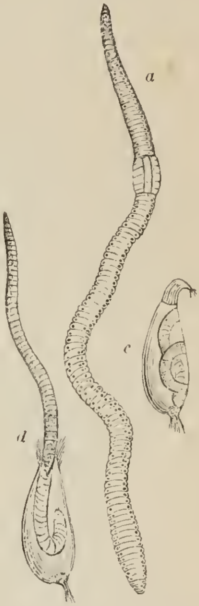


Gôr′ dĭ ŭs a quat′ ĭ cus.
Hair-worm.

CLASS ANNELIDA (ăn nĕl′ĭ dȧ).

This class includes the higher developed segmented Vermes: the Earth-worms, Sea-worms, and Leeches. The body is elongated, and traversed for its entire length by the alimentary tract. The nervous system consists of a brain proper, placed over the *œsophagus* (the anterior portion of the alimentary tract), round which, on each side, a nervous cord passes, connecting with a ventral chain of nervous ganglia. The most noticeable feature, however, is the regular series of segments, each of which has its own nervous center, circulatory organ, respiratory (re spīr′a to ry) system, and, when such are present, organs of locomotion. It is not surprising, then, that when such an animal is divided, the parts continue to show life for some time after the mutilation. ANNELIDS (ăn′ nĕl idz) are found in damp soil, and in both fresh and salt water.

FIG. 40.



a, *Lŭm′ brĭ cus ter rĕs′tris*. Angle or Earth-worm. *c*, Egg, inclosing two young. *d*, Escape of young from egg.

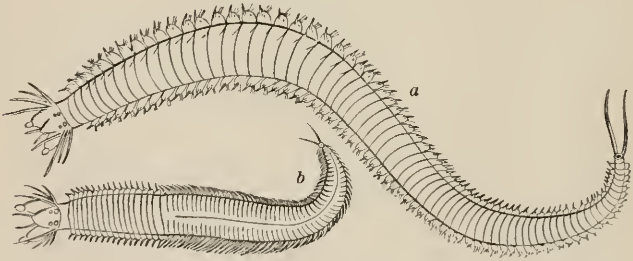
ORDER OLIGOCHÆTA (o lī gō kē′tȧ)

The common **Angle** or **Earth-worm** is abundantly found in the loamy soil of both continents. In tunneling, it swallows the dirt, leaving the alimentary tract to select what little organic matter may be contained. Along each side of the body are rows of small spines, of use in holding to the walls of its tunnel; these can be felt if the animal be allowed to crawl between the fingers. This worm is nocturnal in its habits. It requires moisture, dying in a short time if exposed to the sun's rays. Extreme cold it can not endure; but during winter, it sinks below the frost line and, with several companions, remains coiled up until the advent of spring. Besides its ordinary diet, it is known not infrequently to attack vegetables and even refuse meat. Whenever feeding, however, it invariably disposes of the worthless matter by throwing it out as spiral casts on the surface, at the mouth of its tunnel. This bringing up from below and depositing on the surface, results in a constant overturning and enriching of the soil. It also undermines, at a rate perhaps of an inch in a dozen years, pieces of stone and other debris, which are thus constantly disappearing from the surface. Its eggs are deposited in the soil and develop directly into Earth-worms.

ORDER POLYCHÆTA (pol ĭ kē′tȧ).

Many of the **Marine-worms** (*Nereis*) have the appendages of the sides of each segment greatly enlarged, with expansions which functionize as gills, and with tufts of elongated bristles. The *Clam-worm*, so named because it is often brought to light where these mollusks are being dug, well illustrates such a form. The head is quite distinct, surrounded with long feeling organs, the *antennæ* (ăn tĕn′nē), and bears one or more pair of eyes. From the mouth can be protruded a long *proboscis*, which is armed with terminal teeth and secures the animal's prey, finally drawing it into the stomach. With such well-developed and specialized organs, we should expect to find the Clam-worm an active animal, and such it is. At night, it is known to leave its submarine and sub-

FIG. 41.

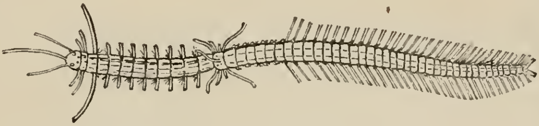


Nē′re is pe lăg′ĭ ca. Clam-worm. *a*, Male. *b*, Female. (Natural size.)

terranean tunnels, come to the surface of the water, and there swim about. Some species reach eighteen inches in length.

The famous **Autolytus** (a̤ tŏl′ĭ tŭs) is also a marine Annelid, and a closely related form. The young of this animal have a general resemblance to the Clam-worm, though they are of much smaller size. After the worm wanders about for some time, one of its middle segments begins to take on the appearance and structure of a head and the posterior part of a body, and finally breaks away, a complete animal, free to move about and to deposit eggs. These eggs will produce other worms, which will, in their turn, go through the same process of self-division.

Fig. 42.



Au tŏl′ y̆ tus cor nū′ tus, subdividing into two individuals.

ORDER DISCOPHORI (dis kŏf′ŏ rī).

The **Leeches** generally have the mouth surrounded by a sucking disk, while there is also a similar disk on the posterior end of the body. Dissection reveals a metamerous (me tăm′ĕr ŭs) (in parts or segments) arrangement, for the digestive, nervous, and excretory systems. The Leeches used in medicine, are imported from France, where they are raised in large numbers.* The mouth is provided with three small lance-like teeth, which readily puncture the patient's skin, causing a painless flow of blood. During the warmer months, they crawl from the water and deposit their eggs in the moist mud. These in a few days hatch, the young at once seeking the water. Several allied forms inhabit our fresh-water ponds and streams.

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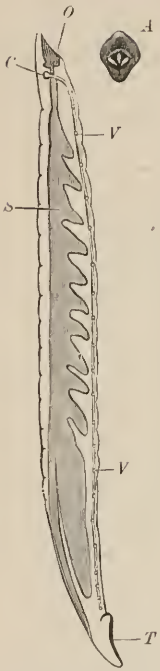
* The Leeches grown in our own waters, especially the genus that furnishes the large variety, serve also for medicinal purposes; and, if baited by applying a little blood to the inflamed part, will attach themselves as readily as the imported ones. When gorged, they let go their hold of their own accord. If then a little salt be put upon their sucking disk, they at once disgorge themselves and are again ready for service.

FIG. 43.



Hĭ rū′do me dĭc i nā′lis. Medicinal Leech, showing chief points in its anatomy. *O*, Mouth. *S*, Stomach. *C*, Cerebral ganglion uniting with the ventral chain of ganglia, *V*, through the œsophageal ring. *T*, Terminal sucker. *A*, View of mouth, showing the three lance-like "teeth."

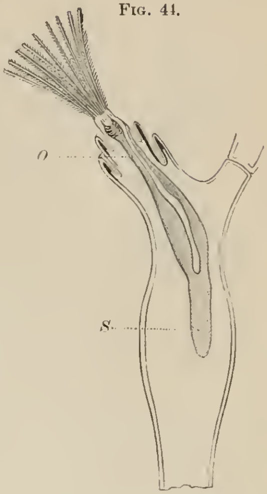
We now come to a few worm-like animals, the precise relations of which are not settled. The **Polyzoa** (pŏl ĭ zō′ȧ), and **Brachiopods** (brăk′ĭ o pŏdz), though generally classified with the worms, present affinities with higher forms, and are regarded by some naturalists as belonging to a separate Branch, the MOLLUSCOIDEA (mŏl lŭs koi′de ȧ).

The **Polyzoa**, though found in fresh-water, abound in the ocean, where their small calcareous, or horny, capsules form incrustations over nearly every submerged object. These capsules, each of which contains a Polyzoon quite distinct from the others, are often arranged in a branching form, giving the colonies a strong, though superficial, resemblance to the branching Hydroids.

Through the thin wall of the capsule, the structure of the animal can often be determined. The mouth, surrounded by a number of ciliated tentacles, opens into an elongated and complete alimentary tract, through the walls of which the products of digestion reach the body cavity, without the intervention of a circulatory system. A series of muscles enables the animal, on being irritated, to retract itself into its supporting cup, where, by drawing a lid over the top, it may seal itself in.*

Polyzoa deposit large numbers of eggs, each of which is capable of producing a new colony. The hard, limy shells have been found in the oldest fossiliferous rocks.

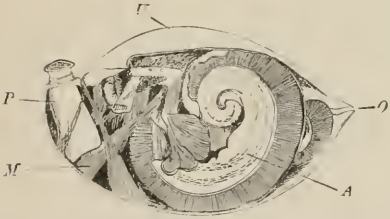
FIG. 44.



Pa lu di cĕl′la eh ren bĕr′gĭ i.
Polyzoon, with its tentacles expanded. *O*, Œsophagus. *S*, Stomach.

The **Brachiopods** are also found, both fossiled, and still living in the ocean. They were long supposed to be allied to the oysters and clams. Recent investigation has shown their unique structure. What were the long tentacles surrounding the mouth of the Polyzoa, have in the Brachiopods united into two groups which are supported by "arms"; these in some forms are coiled in a spiral. These arms, giving the name to the group,

FIG. 45.



Section through Brachiopod, showing anatomical peculiarities. *U*, The upper shell separated from the lower at the opening. *O*. *M*, Muscles which close the valves. *P*, Peduncle, by means of which the animal attaches itself. *A*, The so-called spiral "arm."

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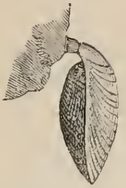
* Some genera have attached to the exterior of the capsules long whips, which keep up a continuous lashing, while others have organs resembling the head and beak of a bird. These open and close until they finally grasp some small object, when for a time they seem satisfied. The real use of these organs is not known.

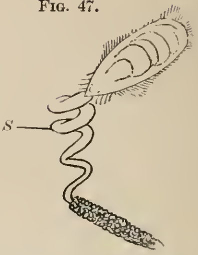
are not capable of extending from between the edges of the shells, which are placed one above and one below the animal. In the **Lamp-shell** of the New England coast, these shells are united posteriorly by a hinge, while projecting from the larger is a short *peduncle* (pe dŭng′kl), which serves to hold the animal to some support. The **Tongue-shells**, of more southern waters, are without this hinge, but have the peduncle greatly elongated, anchoring the animal uprightly in the sand.

Fig 46.



Tĕr e brăt u lī′ na sĕp ten trī o nā′lis.
Lamp-shell.

Fig. 47.



Lĭn′ gŭ la py ram i dā′ ta.
Tongue-shell. *S*, Peduncle, the lower end of which is anchored in the sand.

BRANCH MOLLUSCA (mŏl lŭs′kȧ).

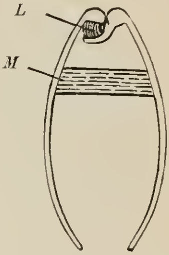
CLAMS, SNAILS, ETC.

This Branch includes animals of which the Clam, Snail, and Nautilus, are examples. The soft body is surrounded by a *mantle*, which generally secretes a limy covering, protected externally from the erosive action of the water by a thin, horny layer—the *epidermis* (ĕp i dĕr′mĭs). The body is bi-symmetrical, though in some forms, a torsion interferes with exact symmetry. The alimentary tract is completely separated from the body cavity, the nutritive fluid being carried over the body, and through the gills, where it is purified, by a system of blood-vessels, which lead to and from a muscular heart. The nervous system is well developed and regularly disposed. Three classes are distinguished.

CLASS ACEPHALA (ȧ sĕf′ă lȧ).

The ACEPHALOUS (ȧ sĕf′ă lŭs) (headless) MOLLUSKS have the sides of the body protected by a pair of shells, or *valves*, from which peculiarity they are sometimes called *Bivalves* (bī′vălvz).* These valves are united by a *hinge*, and holding them apart is an elastic ligament (lĭg′a ment), which, if placed inside, acts by expansion; if outside, by contraction. The valves are closed by one or two bundles of muscular fibers, which the fisherman severs, before he can take out the soft parts. The mouth may be surrounded by a series of tentacles,† to direct the course of the food, which is induced, by ciliary movement, to enter with the water into the mantle cavity. The gills are large and *lamellate* (lăm ĕl′lāt), a characteristic which has given rise to the name *Lamellibranch* (lă mĕl′lĭ brăngk). The so-called "*foot*" is a development of the lower lip, and is of use in burrowing and in locomotion.‡ All Acephalous Mollusks are aquatic.

FIG. 48.



Diagrammatic section through a Clam, to illustrate the opening and closing of the valves. *L*, Elastic ligament, which constantly tends to separate the valves. *M*, Adductor muscle, which, by an act of volition, brings the valves together.

ORDER ASIPHONIA (a sĭ fŏn′ĭ ȧ).

The common **Oyster** of the Atlantic coast, like other members of the class, on hatching from the egg is free to swim about; but soon attaches itself to some support by the left valve, and thus remains anchored for life. An opening in the mantle allows water to enter and bathe the gills, passing around the so-called "stomach," which is a mass of liver and eggs, in which the intestine is coiled.* The **Scallops** (skŏl′lups) are closely allied, though, instead of being sedentary, they are capable of progressing by rapidly opening and closing their valves. The edges of the mantle are in these animals beautifully fringed, and are ornamented with rows of eye-spots. The strong muscle, which closes the shell, is the only portion used as food.

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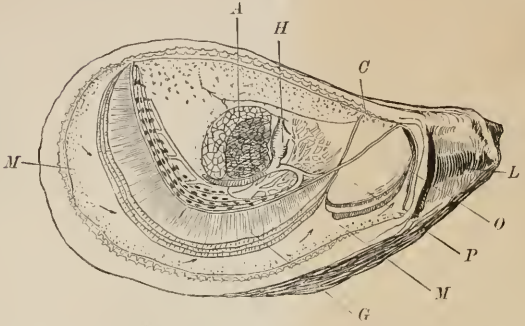
* These are not homologous with those of the Brachiopods, as they are against the sides of the animal, not above and below.

† Compare with mouth tentacles of Polyzoa, page 33.

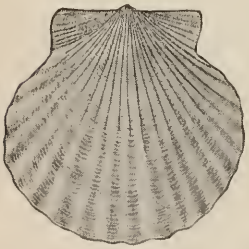
‡ Compare with the creeping surface of Planarian, page 25.

Fig. 49.



Os trœ′ a vir gin i ā′na. Partly diagrammatic view of the soft parts of an Oyster as they lie in their original situation, upon the left valve. *O*, Situation of mouth, on each side of which are the Palps, *P*. *G*, Gills. *M*, Mantle. *A*. Adductor muscle. *H*. Heart *C*, Cut edge of mantle of upper, *right*, side. *L*. Region of hinge of left valve. The arrows indicate the course taken by the water as it enters the mantle cavity.

Fig. 50.



Pĕc′ ten ir rā′ dĭ ans.
Scallop-shell.

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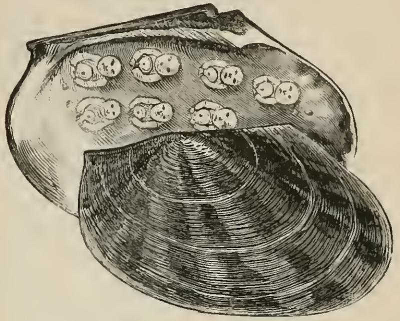
* The hard part, always cut in opening the shell, is the adductor muscle whose office is to shut the valves. These open naturally about one half of an inch. The mantles on the two sides of the shell meet at the aperture. Their edges are fringed with cilia—the English call them the oyster's beard—which can be protruded from the shell and conduct the current which brings inside animalcules and the spores of algæ for food. The lime for building the shell is secreted by the mantle. The heart, shaped like an old-fashioned purse, has an auricle and ventricle, and circulates a limpid colorless blood. If the shell be opened with

The *Pearl-oyster*, the shells of which sometimes measure twelve inches in diameter, is found in nearly all tropical seas. Its exterior is uncouth, but the iridescent lining is one of the most beautiful creations of nature. If any irritating substance, as a grain of sand, should inconvenience the oyster, the animal at once deposits around it layer upon layer of this nacre, thus forming a pearl.*

FIG. 51.



Mel e ăg′ rĭ na mar gar i tĭf′ ĕ ra, with lead images covered with Mother-of-pearl.

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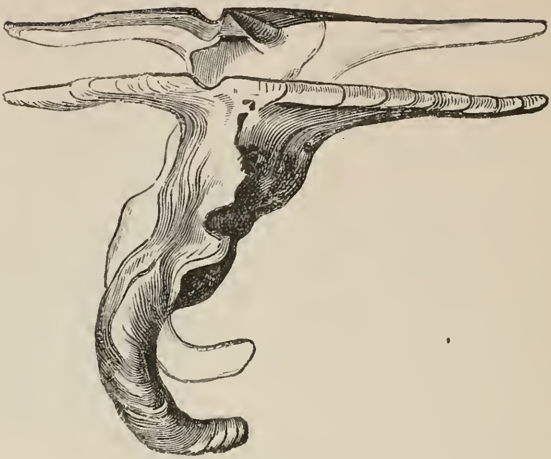
care, the beating of this organ may be distinctly seen. The dark liver is large and secretes a deep yellow bile in large quantity. The mouth is provided with palps by which food is selected and carried inside. The eggs are yellowish, and a single oyster may contain two millions, which, lying in the folds of the mantle, look like thick cream. When the proper time arrives, they are ejected into the water in a milky cloud. Each little oyster, though not larger than the point of a pin—a whole troop being able to swim freely about in a drop of water—has a perfect shell, and is provided with a fleshy pad for attaching itself to any object at hand. Crustaceans, worms, and enemies of all kinds, with a natural liking for raw oysters, flock in to the feast, and a few score only of the millions escape. The survivors anchor themselves to some smooth surface and grow rapidly. In a month, they will be as large as a pea. If we examine a shell, we can see the layers overlapping each other like shingles, each one indicating a season's growth, and the series showing the oyster's age. In three or four years, a marketable size will be reached. The little red crab often found sharing the oyster's home, is the *Pinnotheres ostreum* (Pin no thē′ res ŏs′ trĕ um). The female is generally seen, as the male is scarce. The latter has its back ornamented with a white figure, very like an anchor.—At the discovery of America the oyster was abundant upon the Atlantic coast. Immense mounds of shells lie along the shore, from Maine to Florida. They antedate the time of the Indian, and are so large that in Florida, during the late war, some were used as forts. See Lockwood's "Natural History of an Oyster," in *Popular Science Monthly*, November, 1875.

* Taking advantage of this, the Chinese have long been in the habit of producing pearls artificially by slipping metal images under the mantle and then releasing the animals. In six months, the figures are found overlaid with a pearly secretion. Sometimes, however, the crafty Celestials paste these images upon the interior of a dead shell and then paint it over with a mixture of powdered "mother-of-pearl," in exact imitation of the genuine.

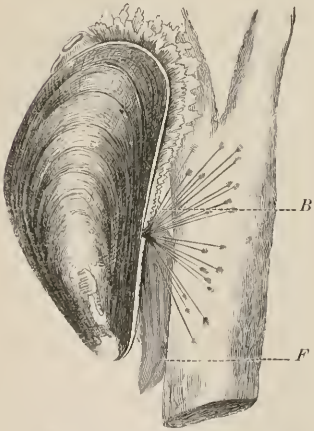
Fig. 52.



Mal' lĕ ŭs vul gā' ris. Hammer-oyster.

The *Hammer-oyster*, of the Indian Ocean, presents one of those singular forms seemingly designed to puzzle naturalists in endeavoring to account for the utility of the anomalous outgrowths.

Fig. 53.

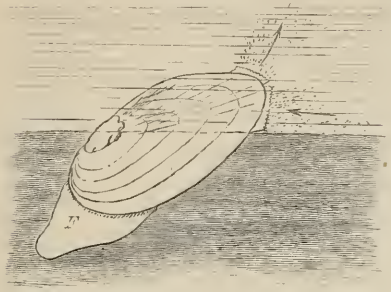


Mȳt' ĭ lus e dū' lis. Mussel.
F, Foot. *B*, Byssus.

The **Mussels** are widely distributed along the marine shores, and in some places, are used in large quantities for food. They are peculiar, in that the water enters the mantle chamber through a short tube, the *incurrent siphon*, and leaves it by another, the *excurrent siphon*. The so-called foot has the power of spinning a number of threads, the *byssus*, which it can throw out one after another and then contract them, a slow movement resulting. The byssus is also of use in attaching the animal to a support.

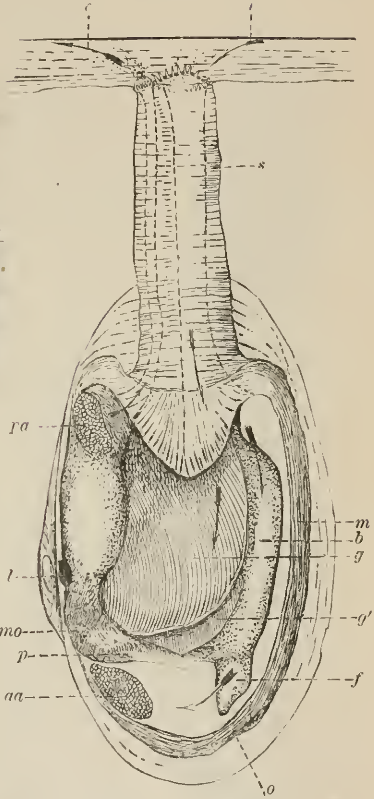
The *Fresh-water Clam*, closely allied to the Mussel, is found in all our lakes, ponds, and rivers. This animal, by means of its elongated foot, plows its way through the mud in shallow water. The young have peculiar hooks on the edges of their valves, by means of which they attach themselves to the fins and gills of fishes, where they remain for some little time.

FIG. 54.



U′nĭ o com pla nā′ tus.
Fresh-water Bivalve, as it moves through the sand. *F*, Foot. The arrows indicate the currents of water entering and leaving the siphons.

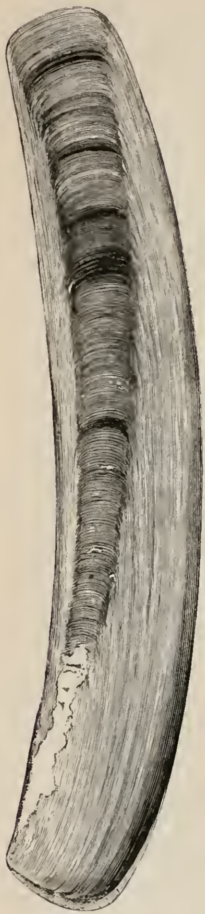
FIG. 55.



Mȳ′a ar e nā′ rĭ a. Common Clam, with left valve and portion of mantle removed, showing the more general anatomical peculiarities. *i*, Arrow showing course taken by water as it enters the siphon (*s*) and bathes the gills, *g* and *g′*. Food is directed to the mouth, *mo*, by the palps, *p*, the water finally leaving the animal through the excurrent opening, *e*. *m*, Mantle, with an opening at *o*, for the foot, *f*, to protrude. The fleshy body is seen at *b*, the ligament at *l*, and the anterior and posterior adductor muscles at *aa*, and *pa*.

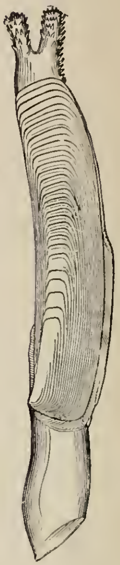
The *Salt-water Clam* has the siphons united and greatly elongated, enabling it, though buried several inches in the mud, to draw in clear water, which alone it covets.

FIG. 56.



Sō' len ĕn' sis.
Razor-clam Shell.

FIG. 57.

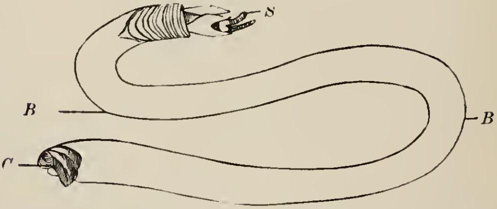


Sō' len ĕn' sis.
Razor-clam.

The *Razor-clam* is found on sandy beaches. Its foot is capable of being greatly elongated and of insinuating itself into the sand for several inches. It is then distended with water, forming a hole, into which the remainder of the animal can be drawn. The eye-spots of the Razor-clam are placed upon the siphons.

The *Ship-worm* is the most aberrant (ab ĕr′rant) of bivalves, and causes a yearly damage of thousands of dollars. The young of this animal is a free swimmer, but soon comes to rest on some submerged timber, as the exposed hull of a ship, or the spiles of a bridge. Into this the animal bores, and in a short time forms long calcareous tunnels, which, while

FIG 58.



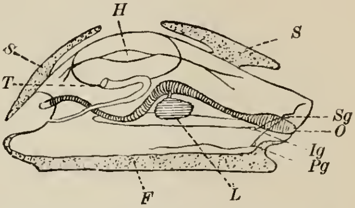
Te rē' do na vā' lis. Ship-worm. *S*, Siphons. *B*, Elongated body. *C*, Rudimentary shell.

never intersecting those of its neighbors, quickly destroys the strongest timber. Its valves are very small, covering only a limited portion of the anterior part of the body.

CLASS CEPHALOPHORA (sĕf a lŏf′ŏ rȧ).

To this class belong mollusks which are generally capable of locomotion, moving about on their so-called foot. Placed anteriorly is the head, which generally bears tentacles and eyes, and is pierced by the opening of the mouth. The alimentary tract is well developed, and bears anteriorly a series of characteristic teeth, the *odontophore* (ō dŏn′tŏ phōr).* Though in many forms the body is protected by the investing mantle only, the greater number have a single hard, limy shell, into which they can partly or wholly contract. Representatives are found in the ocean, in fresh-water, and on land. Some, therefore, are obliged to breathe air, and are consequently provided with lungs.

FIG. 59.



Diagrammatic view of Cephalophorous Mollusk, showing main points in its anatomy. *O*, Mouth, leading into the elongated alimentary tract, which has opening into it, the duct from, *L*, the Liver. *Sg*, The supra œsophageal, or cephalic ganglion, connected by nervous rings with, *Ig*, the infra-œsophageal and, *Pg*, the pedal ganglia. *F*, Foot or creeping disk. *S*, Shell *H*, Heart, the space surrounding which is in communication with the exterior through the tube, *T*.

The present class has been designated by several names: CEPHALOPHORA in that they bear a head; UNIVALVES (ū′nĭ vălvz), because of the single valved shell; and GASTEROPODS (găs′ter ŏ pŏdz), because the foot supports a portion of the alimentary tract.

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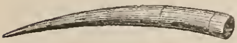
* Compare with teeth of Clam-worm, page 30.

ORDER SCAPHOPODA (skăf o pō′dȧ).

Fig. 60.



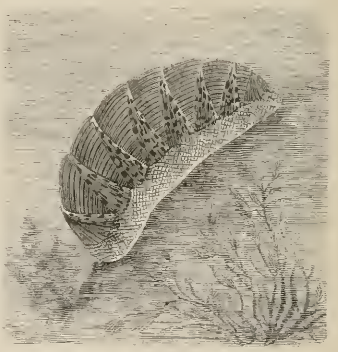
Dĕn tā′ lĭ um dĕn tā′ lis.
Tooth-shell.

The *Tooth-shell* is one of the lowest forms, and, in many points of its structure, resembles the Acephals. The shell, long and tusk-like, is open at each end, allowing the animal to reach out its tentacles and burrow in the sand, while pure salt-water enters the small aperture at the apex.

ORDER POLYPLACOPHORA (pŏl ĭ pla kŏf′ŏ rȧ).

The **Chitons** (kī′tunz) may be spoken of as many-valved Univalves, as they are true cephalophorous (sĕf a lof′ŏ rŭs) mollusks in their structure, though the limy covering of the mantle is divided into several segments. *Chitons* inhabit all rocky coasts, where they securely attach themselves, even during severe storms, by their broad sucking foot.* There are numerous species, and to locate them precisely in their relations to other mollusks, has given Naturalists much trouble.

Fig. 61.



Chī′ ton ĕl′ ĕ gans. Chiton.

ORDER NUDIBRANCHIATA (nū dĭ brăng kē ā′tȧ).

The **Nudibranchs** (nū′dĭ brăngks), [*Doris*], are marine forms, often of great beauty. They are termed "Naked-gilled" Mollusks, in that the organs for purifying the blood, appear as papillæ, in some species, of the brightest colors, and often covering the upper portion of the body. A shell, present in the young, is entirely absent in the adult.

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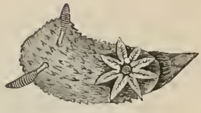
* Some species are now known to have their entire dorsal surface beset with visual organs, it being estimated that 8,000 are borne by a single individual.

FIG. 62.



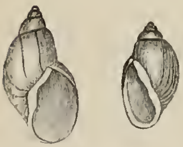
Dō' ris pi lō' sa.
The "gills" are arranged in the form of a star. Anteriorly are seen the club-shaped tentacles.

ORDER PULMONATA (pŭl mo nā'tȧ).

The **Pulmonifera** (pŭl mō nĭf'ĕr ȧ), or **Lung-bearers**, comprise many fresh-water and land *Snails*, without gills. The "lung" is little more than a mere cavity, communicating with the exterior through a valve.

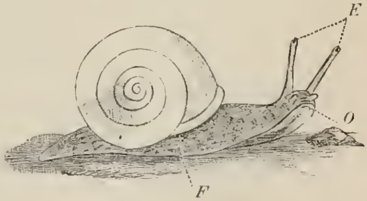
A single swoop of the net, through the aquatic vegetation of some of our streams or ponds, will often secure a score or more of small dark colored snails, which, if placed in a tumbler of water, will reveal many interesting traits. They frequently come to the surface for fresh air, and if a green deposit gathers on the glass, the action of the jaws and odontophore can be observed, as the animal scrapes this off for food. Closely allied to the *Pond-snails* is the common *Land-snail*, or *Helix* (hē'lix). This animal is provided with four retractile tentacles, the larger pair with eyes at their extremity.

FIG. 63.



A Dextral and a Sinistral Fresh-water Univalve.*

FIG. 64.



Hē' lix al bo lī' bris. Land-snail. *F*, Foot. *O*, Mouth. *E*, Tentacles, terminated by the eyes.

Slugs are often found under damp boards, and are sometimes of considerable size. They show on their right side, below the rudimentary shell, the large opening, valve-like in structure, which leads into the "lung." The few remaining forms are marine.

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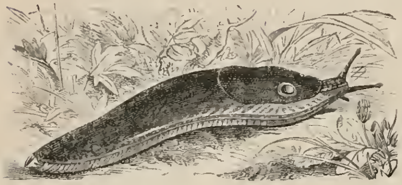
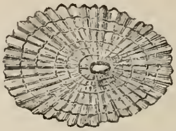
* The greater number of Cephalophorous Mollusks have the opening in the shell turned toward the right, *i e.*, they are dextral.

Fig. 65.



Lī′ max cam pĕs′ tris. Slug.

Fig. 66.



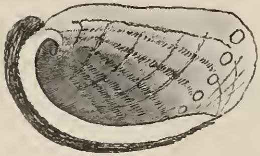
Fis su rĕl′ la lĭs′ tĕr i. **Key-hole Limpet.**

ORDER ZYGOBRANCHIA (zī gō brăng′kĕ ȧ).

The **Limpets** (lĭm′pets) are abundantly found at low tide attached to stones, etc. So firmly can they hold to their attachment, by means of their broad, flat foot, that the shell can be broken before they will loosen their hold. The *Key-hole Limpet* has a small opening at the apex of its shell.

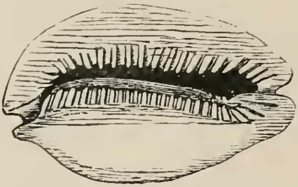
The **Ear-shells**, of the Pacific Coast, also live attached to the rocks. Their shells, of a pearly luster, with resplendent metallic hues, are often sawed in pieces and used in the arts for various ornamental purposes.

Fig. 67.



Ha li ō′ tis ab a lō′ne. Ear-shell.

Fig. 68.

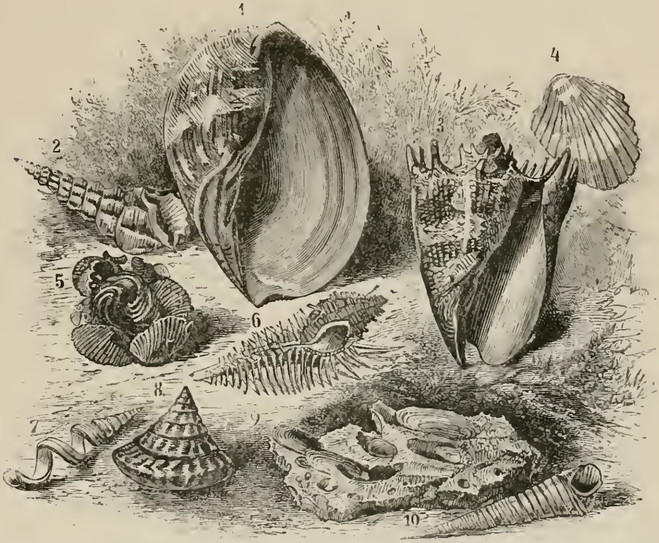


Cy prœ′ a tī′ gris. Cowry-shell.

The **Cowries** (kow′rĭz) are often used as ornaments, the *Tiger Cowry* being most abundant.

The *Conch* (kŏngk), or *Strombus*, a large, heavy shell, with pink interior, found abundantly in the West Indies, makes a favorite ornament for garden beds and door-steps.

Fig. 69.



Shells used for Ornaments.—1. *Cym′bĭ um brŏd ĕ rĭp′ĭ i.* 2. *Ce rith′ ĭ um.* 3. *Vo lū′ta im pe ri ā′lis.* 4. *Car′dĭ um e lā′ tum.* 5. *Phō′rus ag glu′tĭ nans.* 6. *Mū′rex ten ŭ ĭ spī′nus.* 7. *Ver mē′tus e bur′nĕ us.* 8. *Trō′chus ni lŏt′ĭ cus.* 9. *Li thŏd′ŏ mus li thŏph′ă gus.* 10. *Tur ri tĕl′la.*

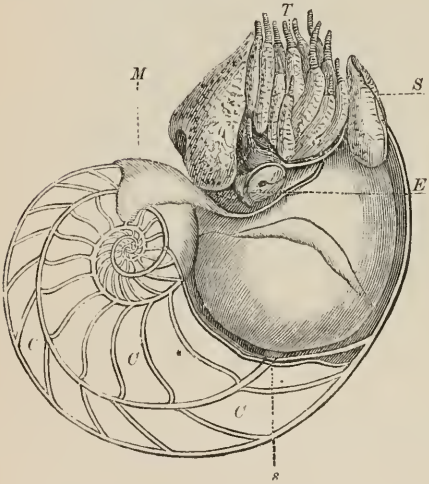
CLASS CEPHALOPODA (sĕf a lŏp′ŏ då).

The Cephalopods (se făl′o pŏdz) have not only an odontophore, but are also provided with a pair of strong jaws, resembling in shape those of a parrot. What was the anterior portion of the foot in the Cephalophora, is here divided into a number of long radiating arms, surrounding the mouth and generally bearing a multitude of cup-like suckers. The eyes are large and well developed, and the brain is protected by a cartilaginous (kär tĭ lăj′ĭ nŭs) box. Covering the internal organs is the thickened, more or less cup-shaped, mantle, between the rim of which and the body, water is free to enter the *mantle cavity*, and bathe the gills. This water may be forcibly ejected through a special fold, the *siphon*, the reaction pushing the mollusk in the opposite direction, often with great velocity.

ORDER TETRABRANCHIATA (tĕt ră brănġ kē ā′tȧ).

The *Pearly Nautilus* (nạ′tĭ lŭs), of the Indian Ocean, is the introductory form. The shell of this animal is found to consist of a series of chambers, arranged in a spiral, all connecting by a *siphuncle* (sī′fŭngk kl) with the ultimate and larger one, which contains the animal. These shells often measure six inches in diameter, and when polished, are very ornamental. The animal has two pairs of gills and numerous arms, which, however, are rather small and unprovided with suckers. Nautili and allied forms, the **Ammonites** (ăm′mon ītz), have peopled the seas since the earliest times; but, though more than two thousand *fossil* species of this order have been described by Naturalists, only six survive at the present time; and these all belong to the genus *Nautilus*,—the sole living representative of what was once a "mighty race."

Fig. 70.

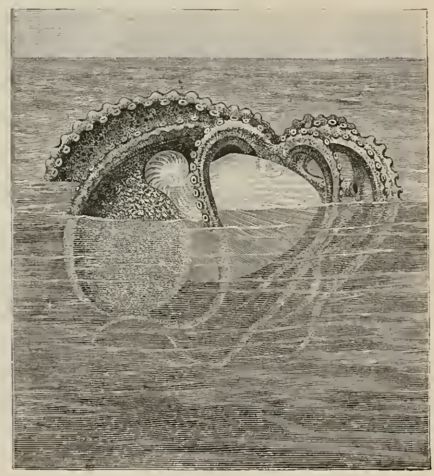


Nau′tĭ lus pom pil′ĭ us. Pearly Nautilus. (⅓.) Section showing chambers and siphuncle. *M*, Mantle. *E*, Eye. *S*, Siphon. *T*, Tentacles. *C*, Chambers. *s*, Siphuncle.

ORDER DIBRANCHIATA (dī brăng kē ā′tȧ).

The "two-gilled" **Cephalopods** have the shell, when present, internal, and either calcareous or horny. When horny, it is long and pen-like, supporting the body. An ink-bag is invariably present, the contents of which the animal, on being frightened, ejects, as a cloud, into the water, to hide its escape. The body is often capable of rapidly changing its color.

FIG. 71.

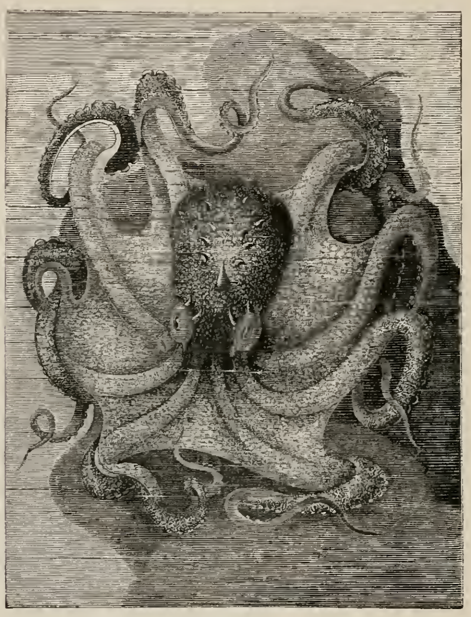


Ar go nau′ta ăr′go. Paper Argonaut.

The *Argonauts* (är′ḡo na̤ts) are so called from the fabulous account of their using their delicate shell as a boat, some of their tentacles as oars, and others expanded, as sails. Though the male is shelless, the much larger female secretes a delicate unchambered shell, in which she rests and where she deposits her eggs, but to which she is not attached, holding it merely, and swimming rapidly about by forcibly ejecting water through her siphon.

The *Octopus* (ŏk′tŏ pŭs), instead of being found in deep seas like the Argonaut, inhabits the rocky shores. This animal, often called the Devil Fish, and about which the most blood-curdling stories have been told, is really of a timid and retiring disposition. The body is short and oval, while the arms are elongated and provided below with two rows of sucking disks. *Baird's Octopus* has been captured several times off the New England coast.

FIG. 72.



Oc'tŏ pus vul gā' ris. Devil fish, or Poulpe.

A larger Pacific form is known to devour great quantities of Acephalous Mollusks.

The *Cuttle-fish* and *Squids*, the most active invertebrates, have, in addition to the eight arms, a pair of longer arms, provided at their extremities only with suckers.*

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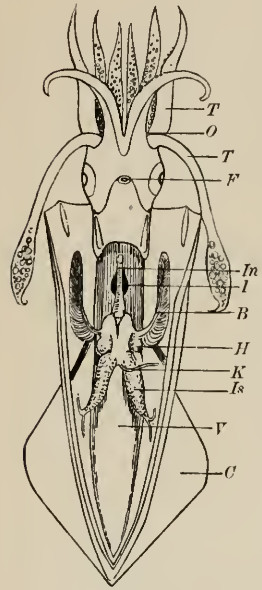
* These monsters of the deep have furnished material for the novelist and the painter. See Victor Hugo's "Toilers of the Sea," and *Harper's Magazine*, Vol. XXI, page 185. Their accounts are greatly exaggerated. Mr. Beale, in his Natural History of the Sperm-whale, describes a specimen of the so-called "Rock-squid," not larger than his fist, but with arms expanding four feet. He grasped one of its tentacles, but the cuttle-fish held to the rock with its suckers so strongly as to resist all his strength. A sudden jerk exasperated the animal, which fixed its

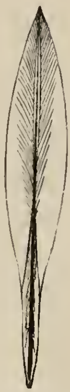
The *Cuttle-fish* is common along the shores of the Mediterranean, where large numbers are captured for food, for their ink, which is made into the pigment sepia (sē′pĭ ȧ), and for their supporting calcareous shell. Allied are the *Squids*, some of which grow to an enormous size. A specimen was lately found on the Newfoundland Coast, whose body measured over seven feet in length, while the arms extended for thirty feet. These animals are carnivorous, devouring large numbers of fish, as well as other mollusks. Migrating in schools, multitudes are destroyed by the whales and other marine animals. Along our shores they often become stranded, and perish in their efforts to again reach the water.

FIG. 73.



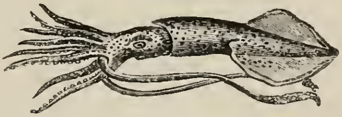
Lō lī′ go peale′ ĭ ī.
Anatomy of a Cephalopod Mollusk, Squid. *T*, Tentacles, bearing their rows of suckers. *O*, Mouth. *F*, Siphon. *In*, Intestine. *I*, Ink-bag. *B*, Gills. *H*, Heart. *K*, Blood-vessel. *Is*, Sac, which receives the impure blood as it returns from the body. *V*, Visceral sac. *C*, Lobes of tail.

FIG. 74.



Pen, or Backbone of Squid.

FIG. 75.



Lo lī′ go bar trăm′ ĭ i. Squid, Atlantic. ($\frac{1}{6}$.)

glaring eyes upon its tormentor and, suddenly releasing its hold, sprang upon his naked arm and endeavored to reach him with its beak. Its slimy grasp sickened, while its threatening look so alarmed him that he loudly called for assistance. His release was at last effected only by killing the cuttle-fish with the boat-hook and cutting off its arms bit by bit.

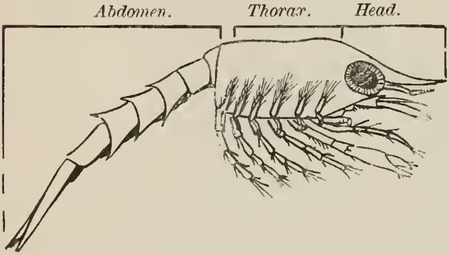
BRANCH ARTHROPODA (är thrŏp′ŏ dȧ).

INSECTS AND CRUSTACEANS.

The ARTHROPODS (är′thrŏ pŏdz) differ from the jointed, bilaterally symmetrical animals, which we have hitherto studied, in having the appendages jointed,* and the body protected by a hard external shell,† which is generally divided into regions, each of which has special duties to perform.‡

Locomotion is effected by the *jointed* appendages, which allow the body to progress without the flexions so characteristic of the worms. The nervous system consists of a brain, situated in the head, connected with a chain of ventral ganglia by means of an œsophageal (ē so făġ′ĕ al) ring. The alimentary tract is entirely separated from the body cavity, while the circulatory system is more or less imperfect. The blood, generally colorless, on leaving the dorsally situate heart, passes through *lacunæ* (la kū′nē) (open spaces in the body cavity) before it again enters regular blood-vessels on its return.

Fig. 76.



An Arthropod Animal. Young Lobster, showing the division of the body into head, thorax, or head-thorax, and abdomen. (Enlarged.)

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* Compare appendages of Clam-worm.

† A rigid support is necessary for the attachment of the muscles which serve in flying, jumping, or swimming.

‡ The head bears the mouth parts and some of the special sense organs; the eyes, and antennæ: the thorax (*thō′ rax*) supports the organs of locomotion: the abdomen (*ăb dō′ men*), generally without appendages, is of use in carrying the eggs.

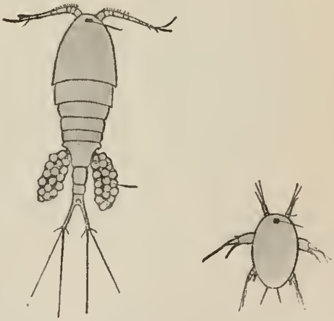
CLASS CRUSTACEA (krŭs tā′shĕ ȧ).

The Crustaceans often have the integument (ĭn tĕg′ū-ment) hardened by the deposition of limy matter. They are mainly aquatic, and hence breathe by means of gills. There are two pairs of antennæ, and the abdomen, as well as the thorax, may bear appendages. Though, on emerging from the egg, the young may resemble, in form, the adult, more often they are born in the *Nauplius* (na̤′pli ŭs) stage, only becoming adults through a series of *metamorphoses* (mĕt a môr′pho sez). The *Nauplius* is of small size, free swimming, but provided with only three pairs of appendages, these finally developing into the two pairs of antennæ and the single pair of jaws.

ORDER COPEPODA (ko pē′pō dȧ).

The common **Copepod** (kō′pĕ pŏd), *Cyclops* (sī′klŏps) is a familiar representative of the group Entomostraca (ĕn-to mŏs′tra kȧ), in which many of the smaller crustaceans, with appendages varying in number, are included. This small white speck is seen swimming with a jerking motion in nearly every tumbler of unfiltered water. If a large specimen be examined with a hand lens, a pair of sacs, filled with eggs, will be found to hang from each side of the abdomen. On hatching from these eggs, the young are in the "nauplius stage."

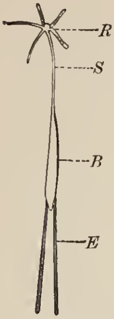
Fig. 77.



Cy̆′clops com mūn′ĭs. Nauplius of Cyclops.

ORDER SIPHONOSTOMATA (sī fon o stŏm′ă tȧ).

Fig. 78.



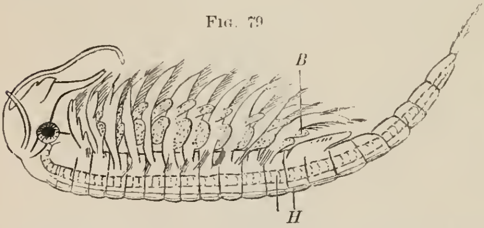
Lern œ o nē′ ma ra di ạ̄′ ta. Fish-louse. *R*, Grapple, by means of which it holds to its host. *S*, Neck. *B*, Body. *E*, Egg-masses.

The *Fish-louse* also comes from the egg as a Nauplius. The adult females are provided with a grapple, by means of which they become attached to their hosts, losing finally, in their parasitic life, all trace of segmentation, becoming mere bags for retaining the juices of their host, and nourishing the large sacs of eggs, which are seen attached at the sides.

ORDER PHYLLOPODA (fĭl ŏp′ŏ dȧ).

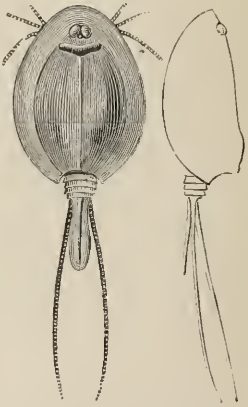
The *Fresh-water Shrimps* are the most familiar representatives of the **Phyllopod** (fĭl′o pŏd) **Crustaceans.** These are found in the spring, swimming about on their backs in the pools of melted snow. *Coues' Shrimp* is found in the small pools of the western prairies.*

Fig. 79.



Branch′ ĭ pus ver nā′ lis. Fresh-water Shrimp, as it swims in the water. *B*, Gills. *I*, Intestines. *H*, Elongated heart. (Enlarged.)

Fig. 80.



Lep i dū′ rus coues′ ĭ ī.

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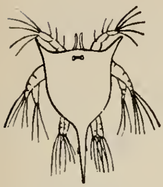
* The eggs of many Phyllopods have the power of enduring desiccation, the pools in which they are deposited drying up in the summer months. Eggs deprived of water for years, have been known to produce young.

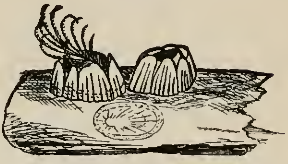
ORDER CIRRIPEDIA (sĭr rĭ pē′dĭ å).

FIG. 81.



Nauplius of Barnacle. (Magnified.)

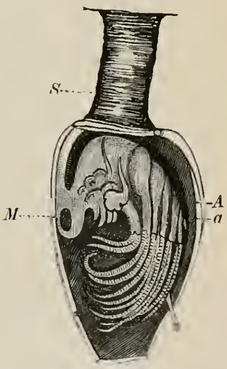
FIG. 82.



Băl′ ă nus bal a noi′ des. Acorn Barnacle. One with its arms extended; one closed in its shell, and circular scar showing the attachment of a third.

The **Barnacles, Cirriped** (sĭr′ri pĕd) **Crustaceans,** are classified in all the older zoologies with the Mollusca. The discovery of the young, a free Nauplius, unites them with the Crustacea. As the Nauplius grows, the anterior pair of appendages become attached to some support, when, by a series of moults, the entire structure of the body is changed. It becomes surrounded by a more or less valved, calcareous shell, from which the animal can at will project six pairs of modified thoracic feet, which secure particles of food and direct them to the mouth. The *Acorn Barnacles* are sessile (sĕs′sĭl), often covering the rocks along the coast, and appearing at low tide as a broad band of white. In this fixed condition, they remain ever after their nauplius stage, being cemented directly to their support. They are not infrequently found on the shells of larger crustaceans, marine turtles, and even whales.

FIG. 83.



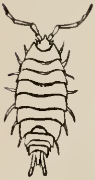
Lĕ′pas an a tĭf′ĕ ra. Goose Barnacle. One side of shell removed, showing the inclosed soft parts. *a*, Position of mouth. *A*, Arm, terminated by long filaments. *M*, Muscle which closes the shell. *S*, Stalk, by means of which the animal attaches itself.

The *Stalked,* or *Goose Barnacles,* are pedunculate, having the delicate shell supported at the extremity of a flexible stem, which in some forms acts as a float, though in general, the pedunculated forms are attached to floating objects.*

The **Sessile-eyed Crustaceans** differ from those hitherto studied in having the thoracic segments, usually seven in number, each bearing a pair of legs. The eyes are compound,† and placed one on each side of the head, which is not rigidly connected with the thorax.

ORDER ISOPODA (ī sŏp′ŏ dȧ).

FIG. 84.



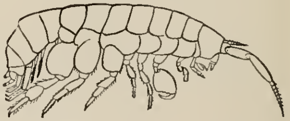
Por cĕl′ lĭ o.
Pill-bug.

The **Isopods** (ī′so pŏdz) abound in the sea and in fresh-water; some, like the *Sow* or *Pill Bugs*, are terrestrial. The body is flattened, the limbs generally resemble each other (hence the name), and the respiratory (rē spīr′a to rĭ) organs are carried beneath the abdomen. The different genera are, for the most part, herbivorous, and hence are of great service in destroying the putrescent matter both in the sea and on the land; while some are wood-borers, and hence injurious to shipping.

ORDER AMPHIPODA (am fĭp′ŏ dȧ).

The **Amphipods** (ăm′fĭ pŏdz) are found in both fresh and salt water, and are particularly abundant on the shore between "tide-marks." They have a compressed body, more or less arched, for springing. The gills are borne at the bases of the thoracic feet.

FIG. 85.



Or chĕs′ tĭ a ăg′ ĭ lis. Beach-flea.

---

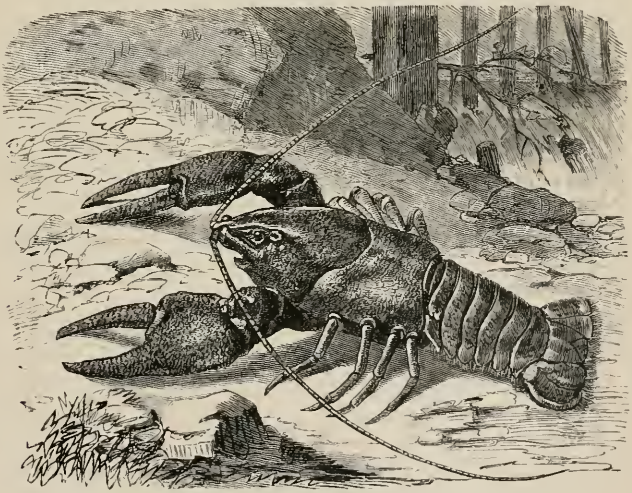
* Several years since, when the hull of the steamer Great Eastern was cleaned, three hundred tons of barnacles were removed from it.

† If the eye of some insect be examined with a hand lens, it will be observed to present a multitude of facets, each of which has the value of a single eye. Such eyes are called compound. We have not met with them hitherto, and indeed shall not meet with them except in Arthropoda.

ORDER DECAPODA (de kăp′ŏ dȧ).

The **Stalked-eyed Crustaceans** include the familiar *Cray-fish*, the *Salt-water Lobster*, and the *Shrimps* proper. The thoracic feet are in five pairs, characterizing the group as **Decapods** (dĕk′a pŏdz). The body is divided into twenty segments, while the head and thorax are joined together, forming a *cephalo-thorax* (sĕf′a lō thō′răx). Though generally aquatic, a few forms have the gill cavity adapted, more or less perfectly, for aërial (ā ē′ri al) respiration. The eyes are placed at the ends of movable stalks. The young usually pass through a peculiar stage, the Zoëa (zō ē′ȧ).*

FIG. 86.



As′ tă cus flu vi ăt′ ĭ lis. Cray-fish, or River Lobster.

The *Cray-fish*, *Lobster*, and *Shrimp* have the abdomen well developed, and capable of forcibly flexing itself, drawing the animal backward through the water with great rapidity. The young *Hermit-crab*, though at first a perfect zoëa, soon looks about for an empty mollusk's shell, of the proper size, into which it backs. As growth proceeds, the body becomes too large for its "house." The animal now looks about and finds a larger one; if this be occupied by a fellow Hermit, he attempts forcibly to eject him, and, if successful, crawls from his old habitation and establishes himself in his new.

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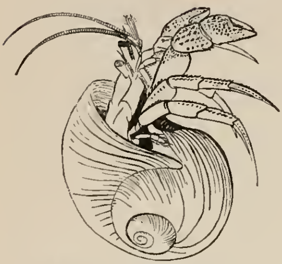
* The terms Nauplius and Zoëa, are taken to describe these early crustacean stages, because the young, when first discovered, were thought to be adult animals, and were given these generic names.

FIG. 87.

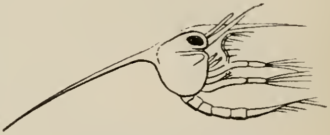


Eu pa gū' rus bern hăr' dus.
Hermit-crab. (Reduced.)

Some terrestrial, air-breathing *Crabs* are said to be sufficiently expert to climb trees.

The *Crabs* proper have the abdomen small, and folded under the greatly expanded thorax. The young are at first active swimmers, passing as such the zoëa stage.*

FIG. 88.



Zoëa of Crab. (Magnified.)

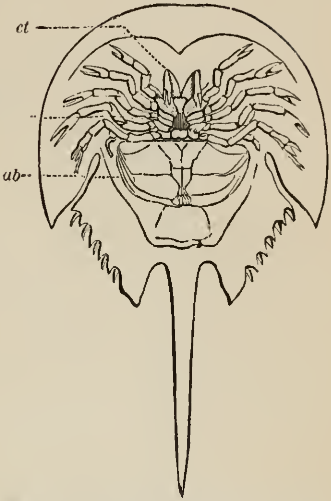
We now come to a few forms whose exact positions are not known. They are not true Crustaceans, nor are they insects; but they seem to occupy an intermediate position. With a single exception they are comparatively of trifling importance in the animal economy, being generally small and of rare occurrence. Of the exception we will now treat.

---

* As growth proceeds in the soft parts, the hard shells of the crustaceans become confining, when moulting is the only relief. This is effected by the shell splitting open, generally along the back, when the animal crawls out and hides its helpless self, until, in a few days, a larger armor has been formed.

ORDER MEROSTOMATA (mē rō stŏm′ă tȧ).

FIG. 89.



Lim′ ŭ lus pol y phē′ mus. Horse-shoe Crab. Under Surface.

The **Horse-shoe,** or **King-crab,** is found on the salt flats of the Atlantic coast. It is provided with a pair of simple and a pair of compound eyes, and has the head and thorax united into a single broad rounded lobe; this bears below it, six pairs of appendages, the bases of which, armed with in-pointing spines, force the food into the mouth. The abdomen is smaller, and below it, attached to five of the six pairs of flattened appendages, is a series of gills.*

CLASS ARACHNIDA (ȧ răk′nĭ dȧ).

The **Mites, Scorpions,** and **Spiders,** are provided with simple eyes only, though they resemble the Horse-shoe in not having the head distinct from the thorax, in being destitute of antennæ, and in having six cephalothoracic appendages.

ORDER ACARINA (ă kă rī′nȧ).

The **Mites** and **Ticks** are often degenerate forms, being chiefly parasitic (păr a sĭt′ĭk). The mouth parts are formed for sucking, either vegetable or animal juices, and the segmentation of the body is more or less obscured. The small "red-spider-like" animals, troublesome to florists, and often seen on the bark of trees, appearing as mere animated dots, represent the *Mites.* Others are found in water, sugar, and on cheese. The *Itch-mite* burrows in the flesh, multiplies rapidly, and produces the loathsome disease which gives it its name. The *Ticks* are also parasitic, some infesting man. Quickly burrowing beneath the skin, they can not readily be extracted, without leaving behind portions of the jaws, which, if allowed to remain, soon produce inflammation, often resulting in serious ulcers.

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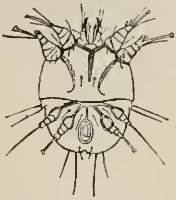
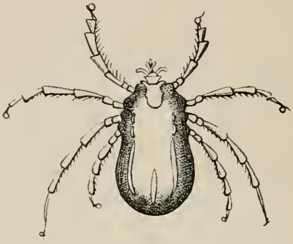
* The *Trilobites* (trī′ lō bīts), which figure so largely in Paleozoic (*pā le o zō′ ĭk*) Geology, present many points of structure in common with the King-crab.

FIG. 90.



Sar cŏp'tes sca bi ē'i.
Itch-mite. (Magnified.)

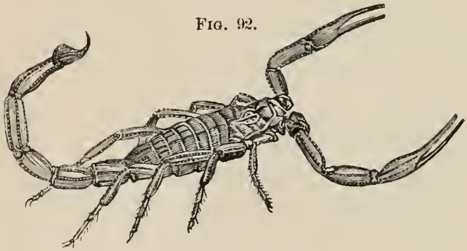
FIG. 91.



Ix ō' des bō' vis. **Western Cattle tick.**

ORDER PEDIPALPI (pĕd ĭ păl′pī).

FIG. 92.



Bū' thus car o lĭn ĭ ā' nus. **Scorpion.** (½.)

The **Scorpions** have the body elongated, segmented, and terminated by a spine-like sting, from near the apex of which poison may ooze through two small pores.* The second pair of appendages are greatly elongated and bear, at their ends, prehensile (pre hĕn′sĭl) organs.

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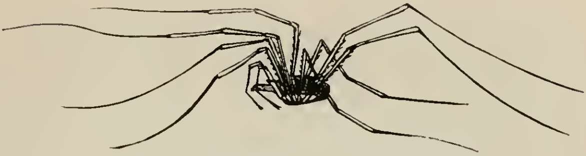
* Though its wounds rarely prove fatal, they are nevertheless extremely painful. Ammonia is said to be the antidote.

Fig. 93.



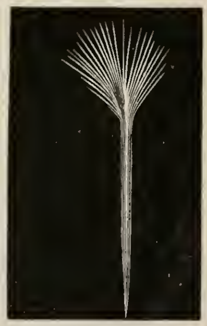
Pha lăn′ gĭ um dor sā′ tum. Daddy-long-legs.

Closely related, though more generally distributed than the Scorpions, are the "Harvest Men," or "Daddy-long-legs," so common about our gardens, where they are beneficial, feeding on small insects which injure the crops.

ORDER ARANEIDA (ȧ rā nē′ĭ dȧ).

The **Spiders,** like the Scorpions, have the head and thorax united, though the abdomen lacks the marked segmentation, is spherical, and is attached to the cephalo-thorax by a slender pedicel (pĕd′i sĕl). The first pair of appendages, the jaws, are provided with openings for the exit of poison, while the second are more foot-like, resembling the remaining four. The most striking peculiarity is the power of web-making. The material for this is secreted as a gluey substance, forced through a series of porous plates situated on the lower side of the abdomen. The fine threads may unite and form a cable, which quickly hardens in the atmosphere. The Spider may attach the web, and, by moving away, more and more material is pulled through the porous plates, the

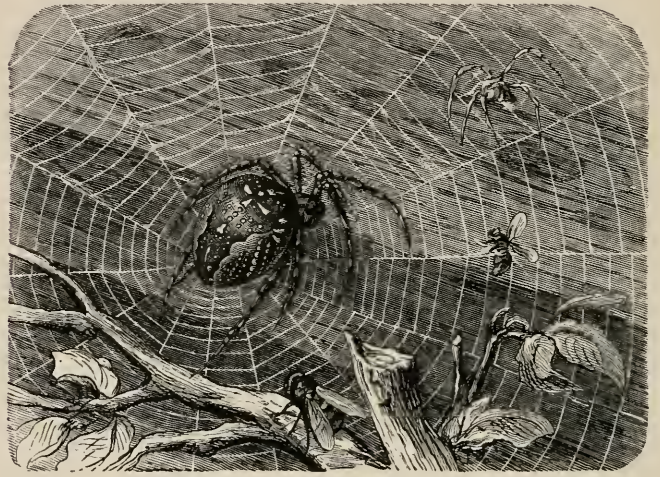
Fig. 94.



Spider's Thread

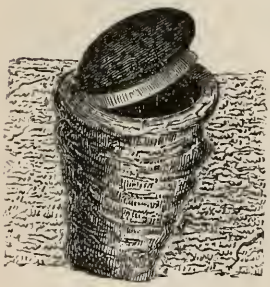
spinnerets (spĭn′ner ĕts); or it may pull out the thread with its feet; or it may even allow the wind to draw it out, until a sufficiently long streamer has been formed, to serve the animal as a parachute (păr′a shụt). The *Geometrical Spider* is so called from the regularity of the radiating and circular lines of its web. The *Trap-door Spider, Mygale hentzii* (mĭg′ă le hentz′ĭ ī), constructs a subterranean home. This is closed with a water-tight trap-door, having an elastic hinge, the outside mimicking the soil around. When the Spider suspects danger, it closes itself into its home and grasps the lower side of the cover, effectually locking it to all its enemies. This species of Mygale is found in the Southern States.

Fig. 95.



E pei′ ra di a dē′ ma. Geometrical Spider.

Fig. 96.



Nest of the Mygale.

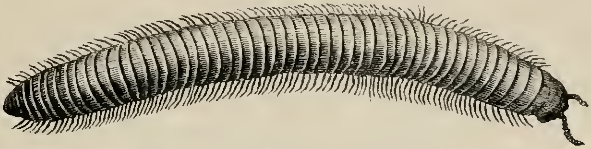
CLASS MYRIAPODA (mĭr ĭ ăp′ŏ dȧ).

The MYRIAPODS (mĭr′ĭ ă pŏdz) introduce us to a different structure. Though the body is worm-like, the appendages are found to be jointed, the head is free, and the thorax passes without interruption into the abdomen. All are terrestrial.

ORDER DIPLOPODA (dĭ plŏp′ŏ dȧ).

The **Millepeds** (mĭl′lĕ pĕdz) are usually cylindrical, with comparatively short antennæ, and have all but the anterior segments bearing two pairs of appendages. Generally, on being disturbed, they coil themselves into a spiral. They are harmless animals, feeding at night on decayed vegetable matter. The *Canadian Thousand-legs*, found about dead wood, is provided with a series of glands, from which, when the animal is disturbed, a disagreeable odor is emitted.

FIG. 97.

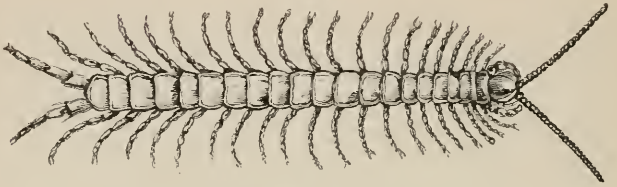


Jū′ lus can a dĕn′ sis. Thousand-legs.

ORDER CHILOPODA (kī lŏp′ŏ dȧ).

The **Centipeds** (sĕn′tĭ pĕdz) are of quite the opposite nature. These have the body more or less flattened, the antennæ elongated, and each body segment never bearing more than a single pair of legs. They are carnivorous forms, having the first pair of legs jaw-like, and provided with a poison apparatus resembling that of the spider. This poison is of use in killing insects and other small animals, and produces great pain and inflammation when inoculated into the human system. The larger and more dangerous forms are found only in the warmer countries.

Fig. 98.

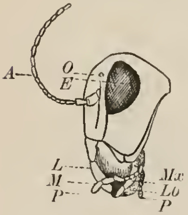


Scol o pĕn′ dra gi găn tē′ a. Centipede. (⅓.)

CLASS HEXAPODA (hĕx ăp′ ŏ då) (INSECTA).

The true Insects have the body divided into three portions: the head, the thorax, and the abdomen. The head bears a pair of large compound eyes, and generally two or three simple eyes; attached movably to it, are four pairs of appendages, from which fact we infer that the head is composed of four segments more or less consolidated. The first pair of appendages is the *antennæ*; next the strong *jaws*, behind which are the *maxillæ* (măx ĭl′lē) with their *palpi* (păl′pī), and, finally, the *labium* (lā′bi ŭm), or lower lip, also with palpi.* The thorax is composed of three segments, each bearing a pair of legs. The abdomen is usually without appendages, and generally has ten segments.

Fig. 99.



Head of Insect. Locust, showing chief points in its external anatomy. *O*, Simple eye. *E*, Compound eye. *A*, Antenna. *L*, Upper lip. *M*, Jaw. *Mx*, Maxilla. *Lb*, Under lip. *P*, Palpus.

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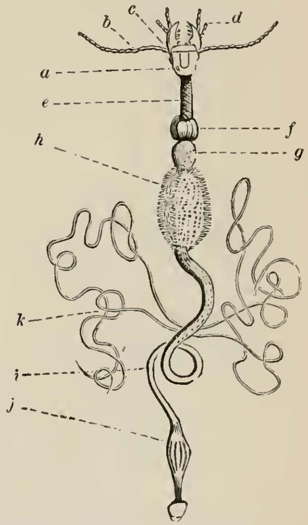
* These mouth-parts enter directly into the economy of the insect's life, and are consequently of the greatest value as aids in classification.

The body of the normal insect, then, is made up of seventeen rings or segments.

The blood is purified by having air distributed over the entire body by means of small tubes, the *tracheæ* (trā′ke ē), the external openings of which are called *spiracles* (spĭr′a klz).

The digestive apparatus (ap pa rā′tus) is more complicated than in Crustacea, as will be seen by reference to the figure.

FIG. 100.



Digestive Apparatus of Insects. *a*, Head. *b*, Antennæ. *c*, Jaws. *d*, Palpi. *e*, Œsophagus. *f*, Crop. *g*, Gizzard. *h*, Stomach. i, Intestine. *j*. Rectum. *k*, Biliary vessels.

The most striking peculiarity, however, is the characteristic series of changes, *metamorphoses*, which many forms pass through before they reach the adult condition.*

Most INSECTS are oviparous (o vĭp′a rŭs). The young, bursting from the egg, is called the *larva* (lär′vȧ). It may be an adult in miniature, or it may resemble the adult in several particulars, as does the young of the Grasshopper (grăs′hŏp per); it may be worm-like, as the young of flies, *maggots*, (by no means true worms); may be provided with walking appendages, as the young of butterflies, and moths, *caterpillars;* or may be *grub-like*, as the young of beetles. In the first case, development is *direct*, *i. e.*, without metamorphoses; in the second, through a series of moults, the *pupa* (pū′pȧ) stage is reached; while a final casting of the skin liberates the adult winged Insect, the *imago* (ī mā′ḡo). In the complete metamorphosis of the fly, moth, and beetle, the young are voracious feeders, storing up sufficient material to enable them to pass the *pupa* stage in quiescence.

---

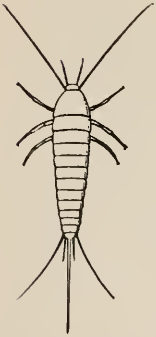
* Compare with metamorphoses of Crustacea.

The several orders may be tabulated as follows:

Development direct, without metamorphosis: No wings.	*Thȳs a nū′ra.*
Metamorphosis incomplete: Wings, four; posterior folded under short anterior...........................	*Der ma tŏp′ te rȧ.*
Metamorphosis incomplete: Wings, four; membranous; reticulate..	*Pseū dō neū rŏp′ te rȧ.*
Metamorphosis complete: Wings, four; membranous; reticulate	*Neū rŏp′ te rȧ,*
Metamorphosis incomplete: Wings, four; posterior folding like a fan.. .	*Ôr thŏp′ te rȧ.*
Metamorphosis incomplete: Mouth-parts formed for piercing and sucking..................................	*He mĭp′ te rȧ.*
Metamorphosis complete: Wings, four; anterior horny; posterior membranous..................................	*Cō le ŏp′ te rȧ.*
Metamorphosis complete: Wings, two; membranous....	*Dĭp′te rȧ.*
" absent.	*Aph a nĭp′ terȧ.*
" covered with minute scales..	*Lĕp i dŏp′ te rȧ.*
Metamorphosis complete: Wings, four; membranous; sparsely reticulate....................................	*Hȳ men ŏp′ te rȧ.*

ORDER THYSANURA (thĭs a nū′rȧ).

Fig. 101.



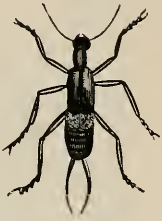
Le pĭs′ma sac cha rī′na. Spring-tail. (Enlarged.)

The **Spring-tails** are placed lowest among the Insects. These small animals are found in damp places, among musty books, under carpets, beneath nearly every piece of bark that has laid for some little time on the ground, in pools of snow water, and even in snow itself. The body is covered with small hairs or scales. The long terminal filaments are often capable of being bent under the body, and, when quickly released, spring the animal a considerable distance. Wings are absent, and the development is direct.

ORDER DERMATOPTERA (dẽr ma tŏp′tĕ rȧ).

The **Earwigs** have a much higher organism than that which is possessed by the Spring-tails, though terminal filaments (fĭl′a ments) are retained, these forming a pincer-like organ. The posterior wings are, during the day, folded beneath the hardened anterior wings, the so-called *elytra* (ĕl′ĭ trȧ).

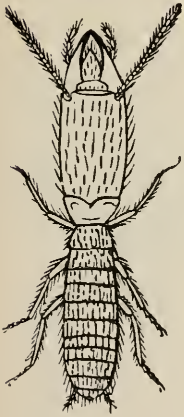
FIG. 102.



For fĭc′ŭ la au ric u-lā′ rĭ a. Earwig.

ORDER PSEUDONEUROPTERA (sū dō nū rŏp′tĕ rȧ).

FIG. 103.

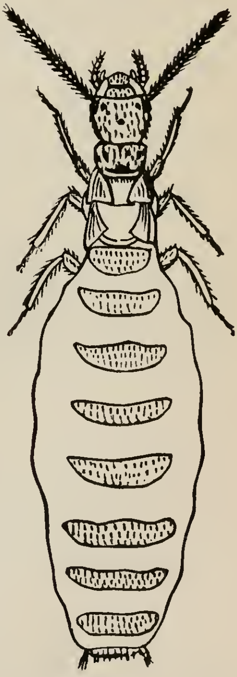


Ter′ mes lu cĭf′ ŭ gus. Soldier White Ant.

The members of this order have an incomplete metamorphosis, the active pupa stage differing from the larva in the possession of "wing-pads."* The lower lip is generally deeply cleft, and the wings, when present, are four in number, reticulate (re tĭk′ū lăt) and membranous.

The *White Ants* (*Termes*), though abounding in the warmer regions, are represented in our country by only a few forms. Differing in many important structural details from the true Ants, they resemble these in their habits, living in large organized

FIG. 104.



Female White Ant, swollen with eggs.

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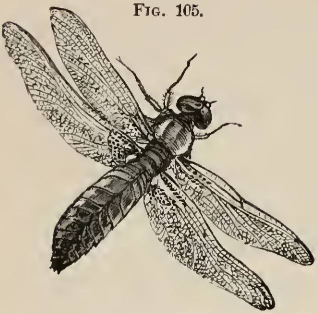
* Rudimentary wings.

communities. The several individuals are the males, queens,* soldiers, and workers. They are extremely destructive to wood-work, and often attack books and manuscripts.

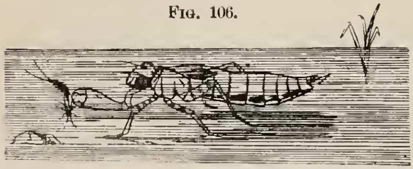
FIG. 105.



Li bĕl′ lŭ la de prĕs′ sa. Dragon-fly.

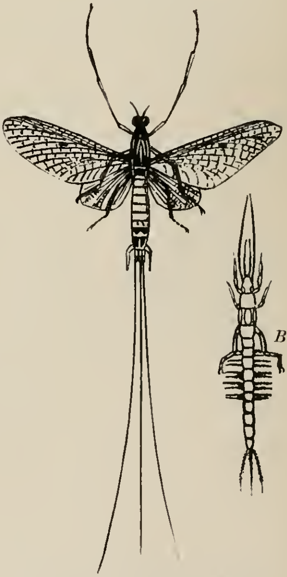
The eggs of the *Dragon-flies*, or *Darning-needles*, are deposited in the water, where the young undergo their metamorphosis. The full-grown pupa finally ascends the stem of some plant, where it splits open along its back, and the adult crawls out, leaving the old shell behind. In this condition (perfectly harmless to man), it continues to lead a carnivorous life, destroying large numbers of mosquitoes, flies, etc.

FIG. 106.



Larva of Dragon-fly.

FIG. 107.



E phĕm′ ĕ ra vul gā′ ta. May-fly.
B, Larva of May-fly.

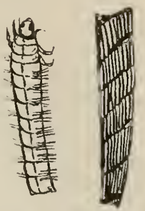
Here also belong the *May-flies*, swarms of which are often seen on warm spring evenings. The young undergo their transformations while in the water; the adults do not feed, and die in a few hours.

---

* At the time of oviposition (*ō vĭ pō zĭ′ shŭn*) the abdomen of the queen becomes greatly enlarged by the presence of the ova. As many as 80,000 eggs have been known to be deposited in a single day from such an animal, of the African species.

ORDER NEUROPTERA (nū rŏp′tĕ rȧ).

Fig. 108.

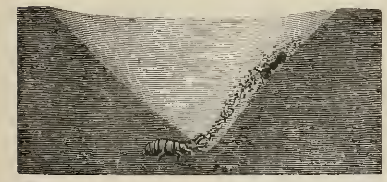


Lim nŏph′ ĭ lus rhŏm′ bĭ cus. Caddis-worm and Case.

Neuropterous Insects have a complete metamorphosis; and the lower lip is without a median (mē′dĭ ăn) cleft. The wings, though resembling those of the previous order, are less reticulate.

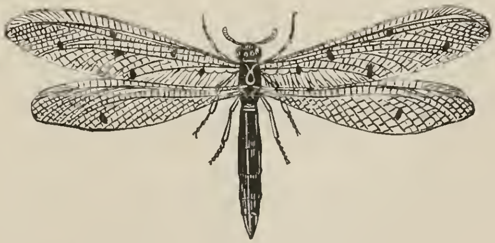
The *Caddis-worms*, found in nearly every small body of fresh-water, are the larvæ of a neuropterous insect, which resembles some of the moths. The pupa stage is passed in a case, the anterior opening of which may be partially closed. The *Ant Lion* is also a larva, and is closely related to the above. It digs a pit, of about two inches in diameter, and lies concealed at the bottom, seizing any insect that tumbles in, and tossing out a shower of sand, to undermine any that try to escape up the sloping sides.

Fig. 109.



Section through pit of Ant Lion, showing the insect in the act of throwing sand on a bewildered ant.

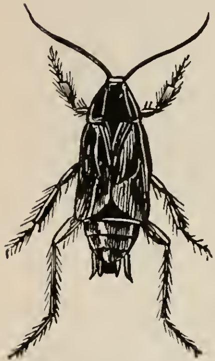
Fig. 110.



Myr mē′ lĕ on for mi cā′ rĭ us. Adult Ant Lion.

ORDER ORTHOPTERA (ôr thŏp′tĕ rȧ).

FIG. 111.

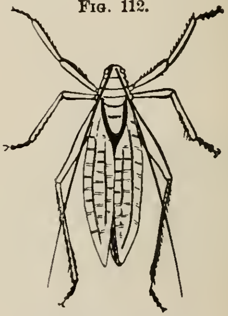


Blăt′ ta o ri ĕn′ tă lis.
Cockroach.

The **Orthopterous** (straight-winged) **Insects** have an incomplete metamorphosis; the fore wings are more or less rigid, reticulate, and parchment-like, while the large hind wings, having the veins straight, can be folded like a fan. As a general rule, the representatives are terrestrial and active from the time they leave the egg.

Few insects have a wider range of distribution than do the omnivorous *Cockroaches*. They are found in nearly every climate. Not only do they inhabit our houses, but their flat bodies enable them to crawl under the bark of trees and beneath stones. They are particularly abundant on board sailing-vessels.

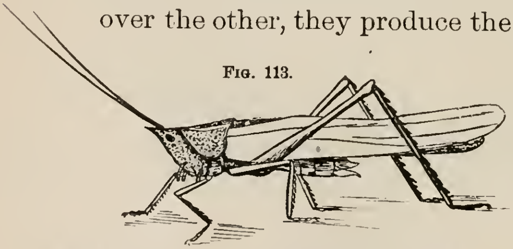
FIG. 112.



Cyr to phy̆l′ lus con cā′ vus.
Katydid. (Reduced.)

The *Katydids* are of much more pleasing appearance. Several species inhabit our trees in summer. By rasping their anterior wings, the one over the other, they produce the call by which they are known. This call may be heard not only at night, but also during quiet summer afternoons.

FIG. 113.

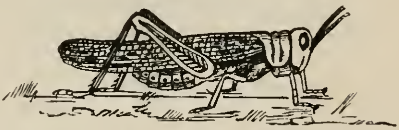


Co no cĕph′ ă lus en′ sĭ ger. Grasshopper, or Quaker.

The *Grasshoppers*, which are provided with long antennæ, resemble the Katydids in being of a pale green color. Their peculiar call has given them the popular name of "*Quakers.*"

The *Locusts* have short antennæ, and are generally of stronger build than the Grasshoppers. They are often migratory. The *Rocky Mountain Locust* has repeatedly laid waste large areas lying west of the Mississippi, a single swarm having been known to destroy the vegetation hundreds of square miles, flying from place to place at a rate of from twenty to thirty miles an hour. The damage done to the Western crops in the years 1874–77 was estimated at one hundred millions of dollars.

Fig. 114.

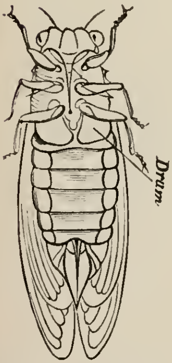


Ca lŏp′ tĕ nus spre′ tus. Rocky Mountain Locust.

ORDER HEMIPTERA (he mĭp′tĕ rȧ).

To this order belong the true **Bugs,** insects having the mouth-parts produced into a long sucking proboscis. The wings, as well as other parts of the body, present a great variety of structure. Metamorphosis is incomplete.

Fig. 115.



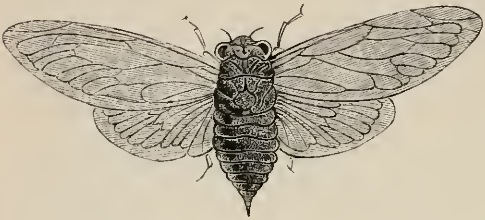
Ci cā′da sep tĕn′ dĕ cim.
Seventeen-year Cicada.

The common *Harvest-fly*, improperly called *Locust*, is one of our largest Bugs, and is familiar to all from its buzzing call, which fills the air during the warmer months.* The female often injures the smaller twigs of trees by gouging long furrows in them, in which it deposits its eggs. The larvæ on hatching, drop to the ground, burrow, and suck the juices from roots. The *Seventeen-year Cicada* (sĭ kā′dȧ) thus lives for about seventeen years; but finally, as a pupa, comes to the surface of the soil, crawls up the trunk of some tree, and attaches its claws. Its shell now splits down the back, and the imago crawls forth. It rests for a time, that its wings may expand and dry, and soon flies away.

---

* This apparatus is concealed under two valves in the upper part of the abdominal cavity. The membrane of the drum-head is thin, brittle, and slightly wrinkled. There is a muscle attached to it on the inner side. By contracting this, the drum-head is drawn in, but on relaxing, it springs back of

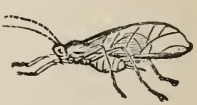
Fig. 116.



Cĭ cā′ da sep tĕn′ dĕ cim. Seventeen-year Cicada.

Closely allied are the *Aphides* (ăf′ĭ dēz), the exquisite little forms which gather on our house-plants.* *Plant-lice* have a wonderful life-history. The eggs deposited on the plants in the autumn hatch in the spring asexual (a sĕx′ū al) and wingless individuals. These produce living young, likewise *asexual*, in succession, often to the twelfth generation. At the close of summer, winged and *sexual* ones appear. These, pairing, their eggs do not hatch until the following spring. This asexual method of propagation is called *Parthenogenesis* (pär the no jĕn′e sĭs). It has been calculated that a single Aphis will give rise to a billion

Fig. 117.



A′phis rō′ sæ.
Plant-louse. (Magnified.)

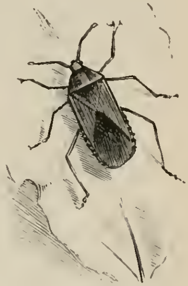
---

itself, thus producing the familiar clicking noise of the Cicada. The pupil can easily make a dissection of the insect, and examine the apparatus for himself, as is hoped he will frequently do in similar cases.

* Nothing can be more amusing than to watch the plant-lice for half an hour, while gorging themselves with the honey extracted from the tender bark. and observe the treatment they receive from the ants, which keep them, as we do cows, extracting from them a sweet liquid, of which they are very fond.

young in a summer. One species [*Eriosoma lanigera*] (e ri ŏs′ŏ ma lan ĭj′ĕ rȧ), covered with a woolly, flocculent (flŏk′ku lent) substance, causes, by stinging the bark, the apple-blight when the leaves turn yellow and drop off. The small *Phylloxera* (fĭl lŏx ē′rȧ), or *Root-louse*, so destructive to grape-vines, is also one of the Aphides. Closely allied is the *Cochineal-bug* (kŏtch′ĭ nēl) of Mexico, the females of which, when ground up, give the rich dye of commerce.

Fig. 118.



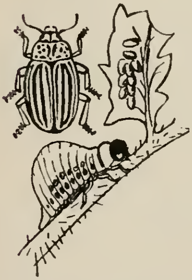
Co′rĕ us trĭs′tis.
Squash-bug.

The *Squash-bug*, like many members of the order, has a most disagreeable odor. The *Louse* and *Bed-bug* are, perhaps, too well known to need either figure or explanation.

ORDER COLEOPTERA (kō le ŏp′tĕ rȧ).

The **Coleoptera**, or **Beetles**, have the anterior wings of a horny texture, meeting, when closed, in a straight line along the back. The posterior membranous wings are the sole organ of flight. The mouth-parts are strong and formed for chewing. The metamorphosis is complete. The larva is the animal commonly called a "*Grub*." This has a well-developed head, three thoracic feet, and the abdomen long and often fleshy. About 100,000 species have been described.

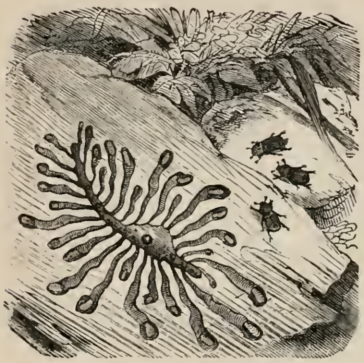
Fig. 119.



Do rўph′ŏ ra dĕ cem lin e-ā′ ta. Colorado Beetle.
Eggs, Larva, Adult.

The *Colorado Beetle*, or *Potato-"bug,"* which, within a few years, has spread itself eastward over the entire country, is the most familiar member of this order. The rapid transformations, from egg to adult, occupy so little time that the descendants from a single pair soon reach the millions.*

Fig. 120.



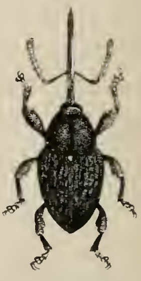
Sco' lў̆ tus de struct' or. Bark-borer.

The *Bark-borers* cause great destruction to trees by digging, just beneath the bark, radiating galleries bearing a rude resemblance to written characters. An egg is placed at the termination of each gallery.

The *Weevils* have a long proboscis for boring holes in which to deposit their eggs. Different species attack different parts of plants.

Balaninus (băl a nī′nus) is peculiar in that its mandibles work vertically instead of horizontally like those of other *Weevils*, and indeed all other *Beetles*. The so-called "worm," found in chestnuts and in hickory-nuts, belongs to this genus.

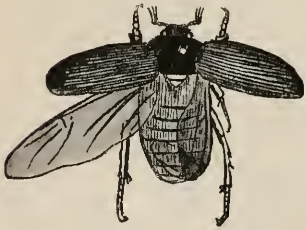
Fig. 121.



Bal a nī̆' nus nū̆'-cum. Weevil.

The *May-beetle*, or *June-"bug,"* lays its eggs in the ground during May or June. These hatch in about three months. The larva, called by farmers the

Fig. 122.



Lach no stĕr' na fŭs' ca. June-bug, showing how the membranous wings are folded away.

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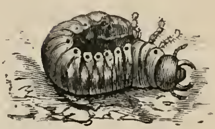
* A single female during a season may attach, in groups of from ten to forty, as many as one thousand eggs. These hatch in a week's time. The larvæ at once begin feeding, and in fifteen or eighteen days equal the parent in size. They now drop to the ground and dig a small hole, in which they rest for about ten days as pupæ. They then come to the surface adult animals, ready to lay more eggs, and so on. In the fall, some of the adults again return into the ground, where they pass the winter.

"white-grub," grows to the size of the little finger, devouring voraciously the roots of vegetables. After remaining some years in this state, passing the winter in the ground below frost, it changes to a pupa, emerges a beetle, feeds on leaves, and finally lays its eggs and dies.

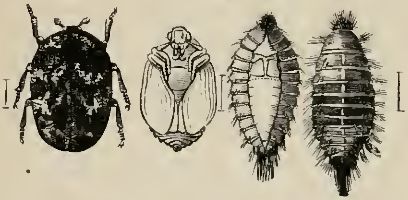
FIG. 123.



Larva.

The "*Buffalo-bug*," or *Carpet-beetle*, lately introduced from Europe, has become one of our most destructive household pests. The larvæ are more destructive than the adults, often ruining collections of natural history, carpets, and clothing, as well as other articles made from animal tissues, such as bristle brushes, whalebone, and shell combs. Closely related, and almost equally destructive, is *Dermestes* (der mĕs′tēz), so troublesome in museums.

FIG. 124.



An thrē′ nus scrŏph ū lā′ rĭ æ. Buffalo-bug.

The *Burying-beetles*, or *Sextons*, are so called from their habit of burying small dead animals in which they have laid their eggs, the young feeding on the decaying bodies.

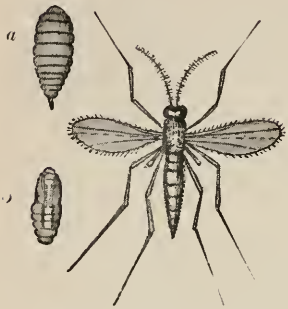
ORDER DIPTERA (dĭp′tĕ rȧ).

The **Diptera**, or *two-winged insects*, have the posterior pair of wings reduced to mere knobs, the mouth-parts formed for sucking, and the metamorphosis complete. America has about four thousand described species.

Though many dipterous insects, like the Flies, are valuable as scavengers, and others pass their larval stages in the bodies of harmful insects, a few are destructive.

The *Hessian-fly* deposits its eggs on the upper side of the leaves of grain, from whence the larvæ, on hatching, crawl to the stem, where they nestle down in the axil, stunting further growth and rendering the joint so weak, that a light storm destroys the plant.

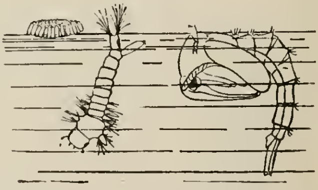
Fig. 125.



Ce ci do mȳ' ĭ a de struct' or.
Hessian-fly. *a*, Larva. *b*, Pupa.
(Enlarged.)

The *Mosquito* deposits its eggs, in boat-shaped clusters, upon the surface of quiet water. The young work themselves free, and in a few days become what is known, from their peculiar mode of progression, as *Wiggle-tails.* These often come to the surface and take in air through a tube near the end of the body. Finally, after several moults, they cease to eat, come near the surface, and move only on being disturbed. This is the pupa stage. The back of the pupa finally splits open and the adult Mosquito crawls forth, resting on its cast skin, until its wings are dry and ready for flight. It is the female only that is provided with piercing and sucking organs.

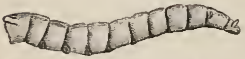
Fig. 126.



Cū' lex pĭp' ĭ ens. Mosquito. Raft of eggs. Larva, taking in air through its tube, and Pupa, also taking in air. (Enlarged.)

The *House-flies* are characterized by their short antennæ, and their sucking and rasping mouth-parts. The footless young, known as *Maggots*, are found in various decomposing animal and vegetable substances. The Fly's foot is provided with a pair

Fig. 127.



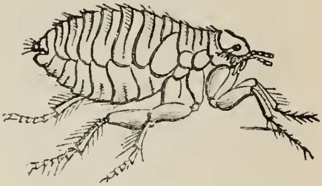
Mŭs' ca do mĕs' tĭ ca. Maggot of House-fly. (Enlarged.)

of fleshy disks, from the viscid secretion of which the animals are enabled to crawl on smooth surfaces, often overhead with their body inverted.

ORDER APHANIPTERA (ăf ă nĭp′tĕ rȧ).

The **Fleas**, which differ from the Dipterous insects in having the body laterally compressed, and the wings rudimentary, belong to this order. Fleas are parasitic on many domestic animals. The eggs find their way, from the hair of the hosts, to the dust in the cracks of floors, where the larvæ, which are provided for a time with jaws, feed on refuse. They then undergo a transformation, finally appearing as adults. The jumping power of the Flea is proverbial, the animal being said to be able to clear a distance of two hundred times its own length.

FIG. 128.



Pū′lex ĭr′rĭ tans. Human Flea. (Magnified.)

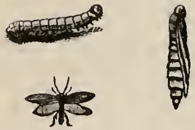
ORDER LEPIDOPTERA (lĕp ĭ dŏp′tĕ rȧ).

This order includes those insects which have all four wings covered with imbricate (overlapping each other) scales; the maxillæ greatly elongated and placed side by side, forming a tube, which, when not in use, is coiled into a spiral; and the jaws, so characteristic in the Beetles, obsolete. The series of transformations is perfect. The larva, *Caterpillar*,' on hatching from the egg, is provided with not only the full complement of thoracic limbs, but there are often from one to five pairs of, so-called, *pro-legs*, fleshy outgrowths along the abdomen. While in this stage, the salivary glands often secrete a silky thread, of use to the animal as it crawls from leaf to leaf, or with many species finally forming a case, the *cocoon* (kō ko͞on′), in which the pupal stage is passed. From the *cocoon*, the adult, or imago (ī mā′gō), finally emerges, and leads a life quite harmless to vegetation.

Two groups of **Lepidopterous** (lĕp i dŏp′ter ŭs) **Insects** have been popularly and scientifically distinguished.

The *Moths* are generally nocturnal, have the antennæ of variable form, and, while resting, fold their wings into a roof, which covers the body.

FIG. 129.

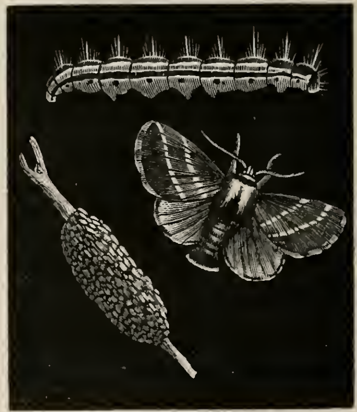


Larva, Pupa, and Adult Clothes Moth. (The first two enlarged.)

The common *Clothes Moth*, or *White Miller* [*Tinea pellionella*] (tin′ĕ a pel li o-nĕl′la), deposits, in the summer months, her eggs on woolen goods, hair, or feathers. These soon hatch, and the larvæ begin their paths, always, however, keeping themselves covered in a case, made from the material on which they feed. Thus covered, they undergo their transformation.

The *Tent Caterpillar Moth* deposits her eggs in a band around the twig of some favorite tree. These hatch in April or May, and the young form a silken tent, in which they remain, until forced by hunger to crawl forth in search of food, leaving behind a trailing thread, which they follow back to their habitation on relieving their hunger. Few birds molest them.

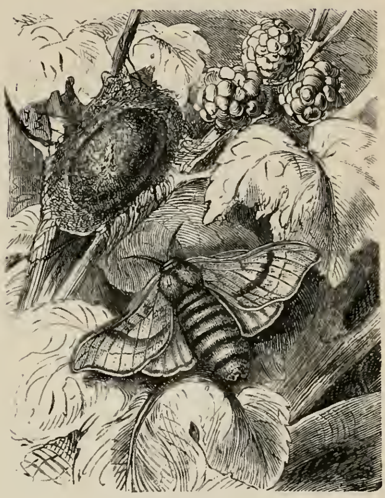
FIG. 130.



Clis i o căm′ pa a mer i cā′ na.
Tent Caterpillar. Eggs, Larva, Imago.

The *Silk-worm*, a most valuable insect, is regarded in quite a different light. Originally from China, it now thrives in all the warmer countries. A single cocoon has been known to yield a strand of silk one thousand feet in length.*

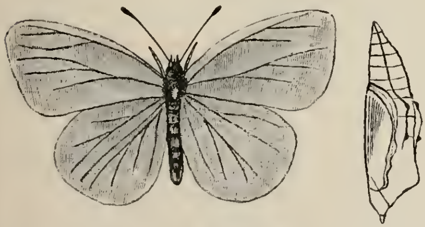
FIG. 131.



Bŏm′ byx mo′ ri.
Silk-worm Moth and Cocoon.

The second group of Lepidopterous insects includes those which are generally diurnal (dī ûr′nal), have the antennæ knobbed at their extremities, and when at rest, elevate the wings so that their upper surfaces are juxtaposed (placed close together). The larvæ never spin a cocoon in which to undergo their metamorphosis, but suspend themselves in some convenient manner, being covered with a hard shell.

FIG. 132.



Pī ĕ′ ris o le rā′ cĕ a. **Cabbage Butterfly and Pupa.**

The imago of the *Cabbage Butterfly* is familiar to all as the light straw-colored Butterfly, with dark markings, seen during the warmer months flitting along the roadside, or over our garden-plats. The larvæ of this and kindred species do great harm in our vegetable gardens, occasioning the loss of thousands of dollars annually.

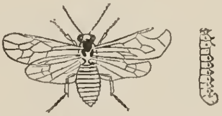
* Tradition has it that the Silk-worm was smuggled into Europe, about the middle of the sixth century, by monks who concealed them in their walking-staves.

ORDER HYMENOPTERA (hī mĕn ŏp′tĕ rȧ).

The members of this order have two pairs of membranous wings, resembling those of the Neuroptera, though they lack the complicated reticulate venation (ve nā′shŭn). The mouth-parts are well developed and formed for both biting and sucking. The metamorphosis is complete, the young not resembling the adult. As the female is generally provided with a sting, situate at the posterior end of the body, the abdomen is often constricted anteriorly to a mere pedicel, giving great freedom of motion to its termination.

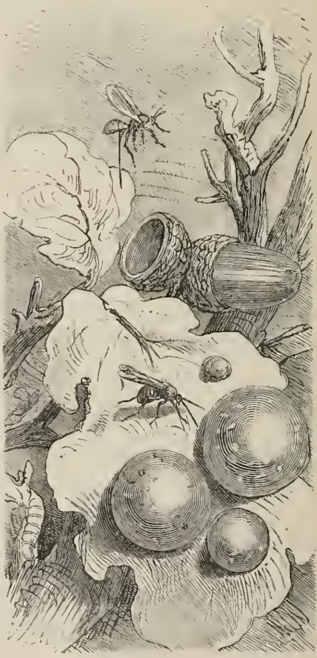
The *Saw-flies* are often very destructive to all forest and shade trees. The female having, with her ovipositor, sawed a slit in a leaf or twig of her favorite tree, deposits therein several eggs, where the young hatches in the midst of plenty. When these larvæ, which strikingly resemble the young of many Lepidoptera, are full grown, they spin for themselves silken cocoons, in which they undergo their transformations.

FIG. 133.



Nem′ ă tus ven tri cō′ sus. Saw-fly and Larva.

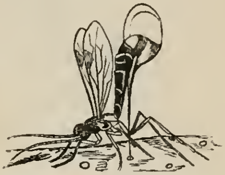
FIG. 134.



Cy̆n′ ips quĕr′ cus fŏ′ li i. Gall-fly.

The *Gall-flies* are of very similar habits, though differing in that the twig or leaf in which the eggs are deposited at once begins an abnormal, though characteristic growth, the so-called "galls." The common *Oak-apple* well illustrates such a gall. Many of the *Gall-flies*, like the Aphides, are parthenogenetic.

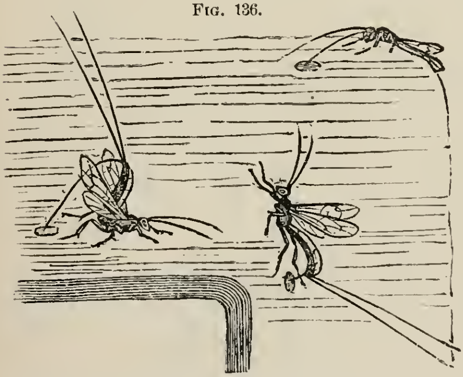
FIG. 135.



Ich neu'mon man i fes 'ā' tor.
Ichneumon-fly.

The *Ichneumon-flies* (ĭk nū′mon), though often microscopic in size, are most valuable as Nature's checks to the inordinate multiplication of other insects. The female searches, until she finds her favorite larva, beneath the skin of which, with her delicate ovipositor, she thrusts several eggs. These, on hatching, feed on the fatty tissues of their host, not attacking the vitals, until they are about to pupate. The unfortunate host thus not only supplies its parasites with food while they live, but finally relinquishes to them its body, as a support in which they are able to undergo their transformations.*

FIG. 136.



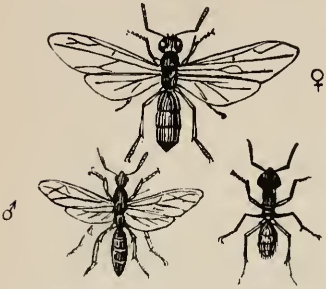
Ichneumon-fly, depositing its eggs in the larvæ at the bottom of the holes.

The common *Ants*, *Wasps*, and *Bees*, excepting the Pseudoneuropterous *White Ants*, in their intellectual development are far in advance of other invertebrate animals. An embryo colony of *Ants* consists of one or several queens, whose sole office is to perpetuate the species by laying eggs. From early spring, until late in the fall, these eggs produce young. The young are without wings, but are provided with strong jaws, and do general work, and in case of invasion, are the fighters; they are hence called the "workers" and "soldiers." Finally, the eggs produced late in the season, produce winged males and females, which leave their homes in swarms in the spring. The males, however, soon die, and the females descend to the ground, tear off their wings, and endeavor either to establish new colonies, or return to their birthplace.*

---

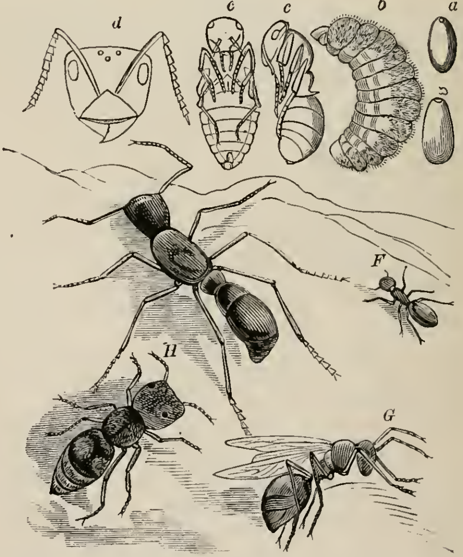
* Few larval insects are free from the attacks of *Ichneumons*. The "grubs" on the inside of solid trees are reached, as are those in the ground, and those under water. Even the larvæ of *Ichneumons*, living as parasites, may play the part of hosts to other parasitic *Ichneumons*, which may in turn be the hosts of a third species of this most interesting group.

Fig. 137.



Female ♀, Male ♂, and Worker of Brown Ant.

Fig. 138.



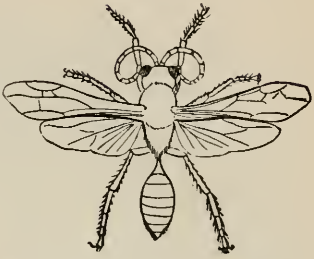
a, Egg. *b*, Larva. *c*, Pupa of Ants. *d*, *Po nē′ ra grăn′ dis*, Giant Ant. *F*, *Fŏr′ mĭ ca san guin′ ĕ a*, Red Ant. *G*, *Myr mē′ ci a for fi cā′ ta.* *H*, *Mu tĭl′ la ceph a lō′ tos.*

---

* Observation has shown that many, if not all, Ants have a language, though just how they communicate their ideas is not known. The *Honey Ants* of the Rocky Mountains, from Colorado to Mexico, are peculiar in that in times of plenty some

The *Digging Wasps* connect the Ants with the Wasps proper. Many dig burrows in the ground or in hard wood, in which they deposit their eggs, leaving food on which the young may feed. Often other insects are paralyzed by their sting, and in this helpless condition are stored away, to await the hunger of the developing *Wasp*. Each species uses different food.

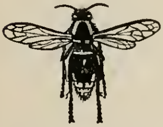
FIG. 139.



Sphex ich neu mŏn' ĕ a. Digger Wasp.

The *Wasps*, proper, have a peculiar life. The female, which, hidden away in some crevice, has endured the winter, comes out in the spring and lays her eggs in a series of small cells, which she has made out of true paper, made by the mixture of her saliva with bits of vegetable tissue. The eggs, on hatching, produce worm-like larvæ, which the queen carefully feeds until they have undergone their transformation, and become able as workers to assist her in caring for her increasing family, and in enlarging their dwelling. In the fall, males and females are developed, but only the latter survive the winter.

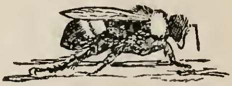
FIG. 140.



Vĕs' pa mac u lā' ta.
Common Wasp, or Hornet.

The *Bumble*, or *Humble*, *Bee*, that has passed the winter, in spring works for herself a small cavity, often in some deserted mouse or bird's nest. In this cavity, with a mass of pollen, gathered from the

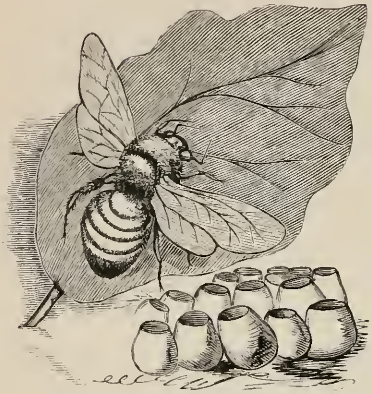
FIG. 141.



Bumble-bee.

of the workers become inactive and are fed by their associates until their bodies become frightfully distended. Thus they remain living storehouses until a time of famine, when they give back their "provisions" to the starving members of the colony.

Fig. 142.

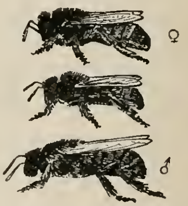


Bŏm′ bus pra tō′ rum. Bumble-bee and Cells.

early opening flowers, she deposits a number of eggs. These soon hatch, when the larvæ feed upon the pollen, and finally spin for themselves pupa cases, from which they soon emerge as workers. They now busy themselves in caring for their newly born sisters. Finally, late in the fall, the queen of this now numerous family, lays eggs which develop into males and females, the former of which, as well as the workers, soon die. The females remain dormant until spring, when they become queens, the founders of new colonies.

The *Hive-bee*, [*Apis mellifica*] (ā′ pis mel lĭf′ ĭ kȧ), which supplies us with honey and wax, has a similar history. When winter begins, the inmates of a hive consist of a queen and a multitude of workers. These huddle together, keeping each other warm, while they feed on the honey which was collected during the summer. As spring approaches, the queen lays large numbers of eggs, perhaps as many as three thousand in a single day. The eggs, placed in ordinary cells filled with honey on which the larvæ feed, develop into workers; those placed in "drone cells," develop into males; and those laid in the much larger cells, constructed on the edge of the comb, develop into queens The colony soon increases in size, and the old queen,

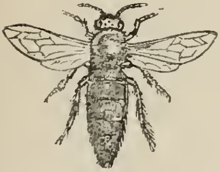
Fig. 143.



Female, or Queen ♀; Worker; and Male, or Drone ♂, of the Honey-bee.

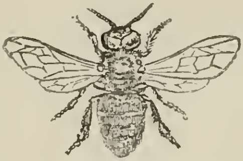
finding that one of the royal young is about to emerge from her cell, collects a number of her workers together and with them leaves the old hive, and the "swarm" starts elsewhere a new colony. The young queen is now assisted from her cell, and either heads a new colony, or carefully visits the remaining royal cells, stings the inmates and establishes herself as the head of the old hive. During the summer, the workers are busy collecting honey, or in making cells in which to store it. The drones (males) are idle and finally, as cold weather comes on, they can be supported no longer, and are consequently attacked by the workers and put to death.

Fig. 144.



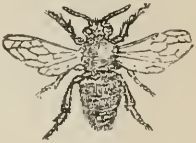
Queen.

Fig. 145.



Drone.

Fig. 146.



Worker.

Europe is the original habitat of the common Honey-bee; but it is now universally distributed, having been introduced to North America about two hundred years ago, and to South America only for about forty years. Its economic value is beginning to be more and more appreciated, especially since the Italian variety has been introduced into the United States. These are claimed to be more docile in their disposition, and more reliable as faithful workers. Works upon bee-culture give explicit descriptions of the several varieties, and should be carefully studied by the Apiarian.

The wax made by melting the comb into cakes, is of commercial value as well as the honey. One of the

Compilers of this treatise furnished to Prof. Jeffries Wyman, of Harvard University, numerous specimens of comb from his apiary, who proved the fallacy of the old theory, that the cells are exactly hexagonal—all being more or less imperfect as mathematical hexagons.

The quality of the honey and wax depends greatly upon the character of the food furnished; and cultivators of bees are accustomed to critically examine the nature of the plants in the region in which they wish to locate.

According to Prof. A. S. Packard, as stated in his "Guide to the Study of Insects," Ichneumon-flies do not attack the larva of the Honey-bee; but adult bees, domesticated and wild, are infested by a variety of parasites, demanding the careful study of the Apiarian. There is also a wax-moth, that is very harmful from consuming the wax, and weaving their webs to the inconvenience of the bees in passing to and fro amid the sheets of comb. The use of improved hives and constant watchfulness is the only preventive against their ravages.

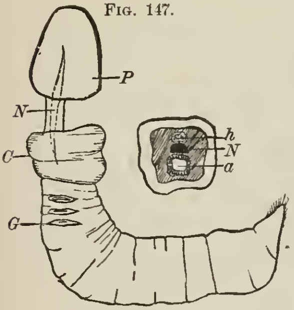
II. THE VERTEBRATES.

BRANCH VERTEBRATA (vẽr te brā′tȧ).

TUNICATES, FISHES, REPTILES, BIRDS, ETC.

The forms which we are now about to meet, have the body supported by an internal rod, which separates the dorsally situate nervous system from the alimentary and circulatory systems; a structure quite the reverse of that exhibited by the dorsally placed heart and ventral chain of ganglia of the previous forms. Limbs, when present, are never represented by more than two pairs, and generally segmentation is not externally apparent. Inasmuch as the supporting rod is generally divided into a series of segments, the so-called vertebræ, these animals are known as VERTEBRATES, in contradistinction to the previous forms, the INVERTEBRATES. Here again, Nature presents us with seemingly intermediate forms, which prevent our drawing definite lines of demarkation.

FIG. 147.



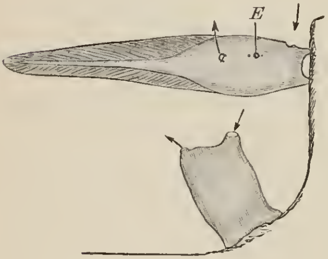
Bal a no glŏs′ sus mi nū′ tus. A young Balanoglossus, having three gill openings, *G*. *P*, Proboscis. *h*, So-called notochord. *C*, collar, through which the section is made, showing relative position of notochord. Nervous system, *N*; and alimentary tract, *a*.

The so-called *Balanoglossus* (băl a no glŏs′sus), long supposed to be a worm, has lately been shown to have, at an early period of its life, a short cartilaginous rod, above which is situate the nervous system, while below is the alimentary tract. This animal is found along the sea-shore buried in the mud.

CLASS TUNICATA (tū nĭ kā′tȧ).

The Tunicates (tū′nĭk atz), also found along the coast, are quite different in their adult structure. They occur either as single individuals of the size of an acorn; or they may be smaller, almost microscopic, and, united in colonies, cover submerged rocks and seaweeds as a gelatinous mass. But it is the young, or larval *Tunicata*, that demands our attention. This, as will be observed by reference to the diagram, has a supporting unsegmented cartilaginous rod, the so-called *notochord* (nō′to kôrd), over which extends the nervous system, and below which is the alimentary tract,—a general structure, resembling that of the young frog. After this stage, however, the *Tunicate* becomes sedentary, retrogrades, and finally loses all vertebrate peculiarities. All the remaining animals may be spoken of as *Vertebrates proper*.

Fig. 148.

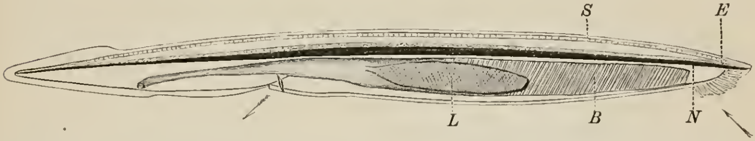


Tadpole-like larva of Tunicata attached by the anterior portion of its body, and adult degenerate form. The arrows indicate the course taken by water and food as they enter the mouth and leave the spinacular opening. *E*, Eye.

CLASS ACRANIA (a krā′nĭ ȧ).

The little Amphioxus (ăm fĭ ŏx′ŭs), or Lancelet (lȧns′let), has long been regarded as a vertebrate animal. It is small and lanceolate in form, seldom exceeding two inches in length. It is generally found buried in the sand of the warmer seas, though it not infrequently swims about with a wriggling motion. On examining the structure of the animal, we find that its supporting skeleton consists chiefly of a slender notochord, running from head to tail. Above this is the nervous system, slightly enlarged anteriorly, where it bears a single eye-spot. Below, and in front, is a large mouth, surrounded by tentacles, which leads into a chamber, the *pharynx* (făr′-ingks), from the posterior end of which extends the œsophagus, which connects with the stomach. Water taken into the pharynx finds its exit through numerous lateral slits, the separations between which are richly supplied with blood-vessels, coming from a ventrally placed pulsating organ. In these supporting arches, the blood is purified by coming so near the water that its impure gases escape, and the free oxygen (ŏx′ĭ jĕn) in the water is taken in. These arches are then used for breathing, and we can speak of them as the *gill*, or *branchial*, arches. The outer openings of the slits are covered by a fold of skin which forms a chamber around them, having a single external pore. The specimen which is represented in the figure, is from the Mediterranean; but one species, less studied, is found in American waters. Six species in all are enumerated by some naturalists.

FIG. 149.



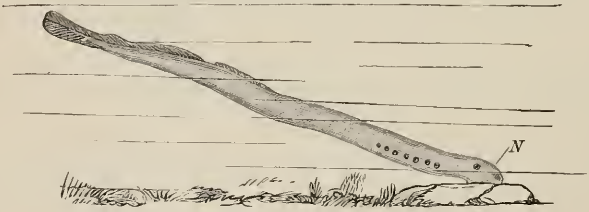
Branch i os′ tŏ ma lan ce o lā′ tum. Amphioxus, or Lancelet, enlarged. *E*, Eye. *N*, Notochord. *B*, Branchial slits. *L*, Liver. *S*, Nervous system. The arrows indicate the entrance and exit of water.

CLASS CYCLOSTOMA (sī klo stō′mȧ).

The Circular-mouthed Vertebrates have a cartilaginous skeleton, naked skin, and no lower jaw. It is here that we first meet with organs of special sense, constructed on the same plan as those of man,—well-developed eyes, internal ears, and a nasal sac.

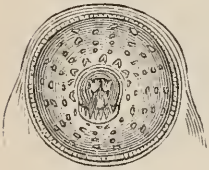
ORDER HYPEROARTIA (hī per o är′tĭ ȧ).

Fig. 150.



Pe trom′ y̆ zon ma rī′ nus. Lamprey. *N*, Nasal orifice.

Fig 151.



Mouth of Lamprey.

The **Lamprey** (lăm′prĕ) is found in both salt and fresh water. Its mouth is simply a circular sucking-cup, armed with numerous teeth. The tongue, working like a piston, produces a vacuum by which the animal adheres to any object. If attached to a fish, its wasp-like teeth enable it to scrape off the flesh for food; if to a stone, assisted by the current, it can drag away quite large ones from the spot it has chosen for its nest. Circulation is effected by means of a heart, the impure blood from the body entering a single auricle (a̤′rĭ kl), and from thence being poured into a muscular ventricle, which forces it over the body by way of the gills. These are bathed by water, which may enter through the mouth; or, when this is occupied, through the round openings along the sides, out of which it is also allowed to escape.

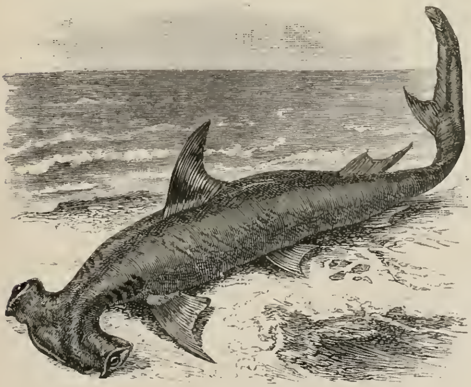
CLASS ELASMOBRANCHII (ē lăs mō brăng′kĭ ī).

The strap-gilled fishes have four or five pairs of long gill openings. Their skeleton is cartilaginous, skin rough, and the tail lobes are of unequal length (heterocercal) (hĕt er o sẽr′kal). It is in this class, we first meet with animals having two pairs of appendages; the anterior (the pectoral) (pĕk′tō răl), and the posterior (the pelvic) (pĕl′vik).

ORDER SQUALI (skwā′lī).

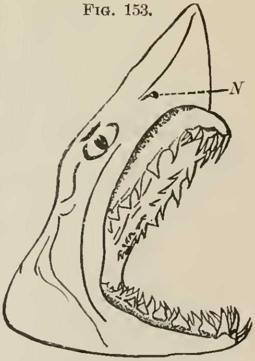
The **Sharks** are the butchers and scavengers of the ocean. They follow ships pertinaciously, swallowing greedily any thing thrown overboard.* Their teeth are

FIG. 152.



Sphy̆r′na zy gæ′nus. Hammer-headed Shark. ($\frac{1}{50}$.)

FIG. 153.



Shark's Teeth.
N, Nasal orifice.

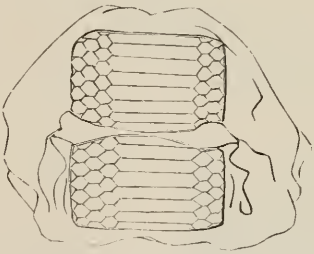
* On slow-sailing merchant-ships, shark-fishing is a favorite pastime. A recent account says: "I was holding the heavy hook and wire rope over the side, when I felt that I had caught a big fish, and pulling it cautiously, a shark came to the surface. I called out for help. He struggled so violently, lashing the water with his tail and trying to bite the hook asunder, that we were obliged to keep dipping

in numerous rows, held by strong skin upon the rounded edge of the jaws; but only the outer row stands perpendicularly and can be used. As fast as any drop out from wear or fracture, inner ones move forward to take their place. The *Hammer-head Shark* is sometimes thirty feet long. Its eyes are at the end of the lateral prolongations of the head, which can be bent so that the shark can see its victim on both sides as it settles down upon it.

ORDER RAJII (rā'ĭ ī).

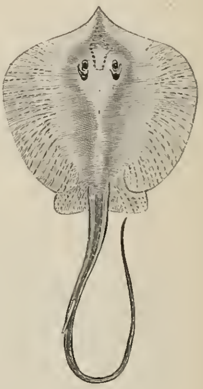
The **Rays** are noted for their enormous pectoral fins, formidable tail, and tessellated teeth. They sometimes weigh half a ton. The teeth are adapted to crushing shell-fish; while the tail, armed with

Fig. 154.



Jaws of a Ray, showing tessellated teeth.

Fig. 155.

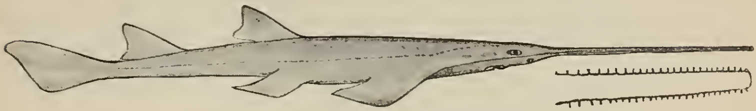


Da sy̆b'a tis cen trū'rus.
Sting-ray.

his head under water and then haul him up two or three feet to let it run down his throat. At last he was nearly drowned, when, sending a running bow-line down the rope by which he was caught, and making it taut under his back fin, we clapped the line around the windlass and turned. Some then hauled his tail up, while all available hands dragged at the other line, which held his head. As soon as we got him on board, he broke off about three feet of the ship's bulwarks by a single lash of his tremendous tail. This was then cut off by the boatswain with a hatchet, while a dozen of us with bowie-knives finished him. We found in his stomach six large snakes, two empty quart bottles, two dozen lobsters, a sheep-skin, and horns, and the shank-bones, which the cook had thrown overboard two days before. The liver filled two large wash-deck tubs, and when tried out, gave us ten gallons of oil."

barbed spines, can be suddenly lashed around an enemy, the barbs frightfully lacerating the flesh.*

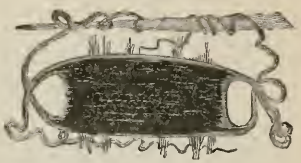
FIG. 156.



Prĭs′tis ăn tĭ quō′ rum. Saw-fish. ($\frac{1}{50}$.)

The *Saw-fish* has a sword-like snout one third the length of the body, and edged with tooth-like spines. Brandishing this among a school of fishes, many are at once disabled, and afterward eaten at leisure. Though many of the Sharks and Rays are viviparous, some are oviparous, their eggs resembling horn-like sacs, with tendrils for clinging to the sea-weed.

FIG. 157.



Shark's Egg, attached to the stem of a plant.

CLASS GANOIDEI (ḡă noid′ĕ ī).

Though GANOID (ḡā′noid) fishes once peopled the waters in large numbers, they are at the present time represented by only a few species, all of which, with a single exception, inhabit fresh-water. They differ from the sharks and rays in that the body is covered with an armor of regularly arranged bony plates, which on the first ray of the dorsal and caudal (kạ′dăl) fins form ridges, known as fulcra (fŭl′krȧ). Though the lower representatives have the skeleton cartilaginous, in the higher forms this support is often of a bony nature.

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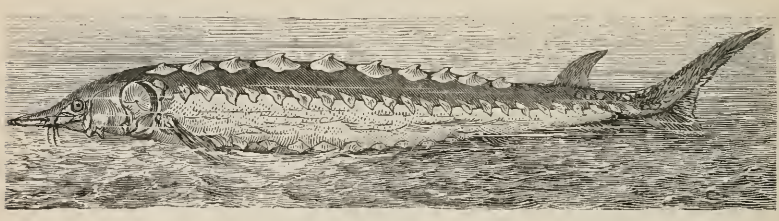
* To this family belongs the famous Torpedo, which, on being touched, gives a violent electric shock. It possesses a kind of voltaic pile, composed of parallel prisms, 1,262 of which have been counted in a single fish. The electricity has been used in galvanic experiments, as making a magnetic needle, etc.

ORDER CHONDROSTEI (kŏn drŏs′tē ī).

The **Sturgeon** has the body protected by five rows of large bony plates. Its snout reaching in front of the mouth is flattened and has four flexible filaments extending from its lower surface. These are seemingly feelers to recognize its food half concealed in the mud, and which is readily seized by its protrudable mouth. Seven different species are found in the coast and interior waters of the United States, varying in weight from a hundred to six hundred pounds. The smaller species inhabit the Mississippi and the great lakes. *Acipenser sturio* (ăs ĭ pĕn′sĕr stū′rĭ ō) is found on both sides of the Atlantic, sometimes attaining on the European coast a length of eighteen feet.

FIG. 158.

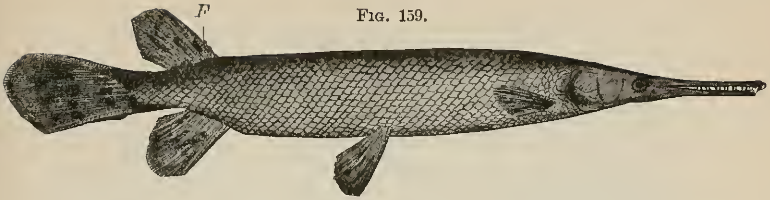


Ac ĭ pĕn′ sĕr slū′ rĭ ō. Sturgeon.

ORDER GINGLYMODI (gĭng glī mō′dĭ).

The **Gar-pikes** are represented by three or four species, one of which, the *Osseus* (ŏs′sē ŭs), is widely distributed in lakes and rivers throughout the United States. Its enameled rhomboid scales in oblique series, its long and slender form, and its projecting upper jaw are characteristics, by which it is readily distinguished from all other

Fig. 159.



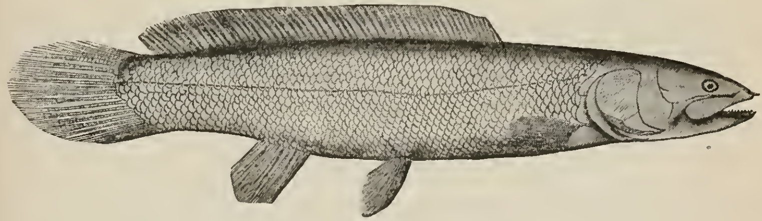
Lĕp ĭ dŏs′ tĕ ŭs ŏs′ sĕ ŭs. Gar-pike. *F.* Fulcrum. ($\frac{1}{6}$.)

fishes. The air-bladder is connected by means of a tube with the œsophagus, and is used as a lung.*

ORDER HALECOMORPHI (hā lē kō môr′fī).

The **Mud-fish**, found in our lakes and rivers from Minnesota to the Mexican Gulf, is the highest Ganoid, and the one most resembling the members of the following class. In confinement, this animal has been observed to come regularly to the surface of the water for fresh air, using its air-bladder, as does the Gar, for a lung.†

Fig. 160.



A mī′ a căl′ va. Mud-fish.

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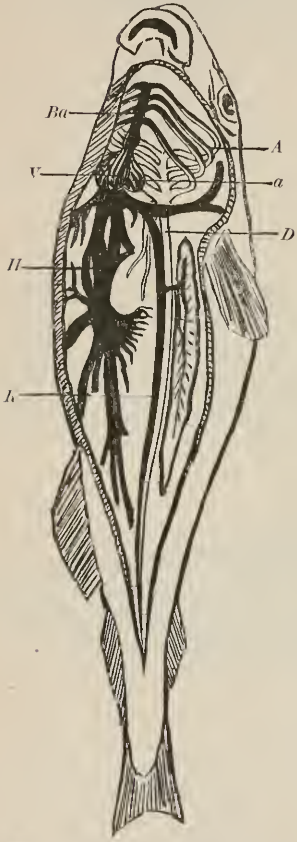
* The air-bladder of higher forms is a sac, containing gas, and is of use in changing the specific gravity of the fish.

† Dr. B. G. Wilder says essentially, "one came to the surface at *intervals* to discharge a bubble of air. Held about six inches below the surface, it still emitted a large bubble. After a second or two of quiet, it escaped from the hand, and apparently gulped in a large quantity of air, and descending, remained quiet the usual interval."

CLASS TELEOSTEI (tĕl ē ŏs′tē ī).

Fig. 161.

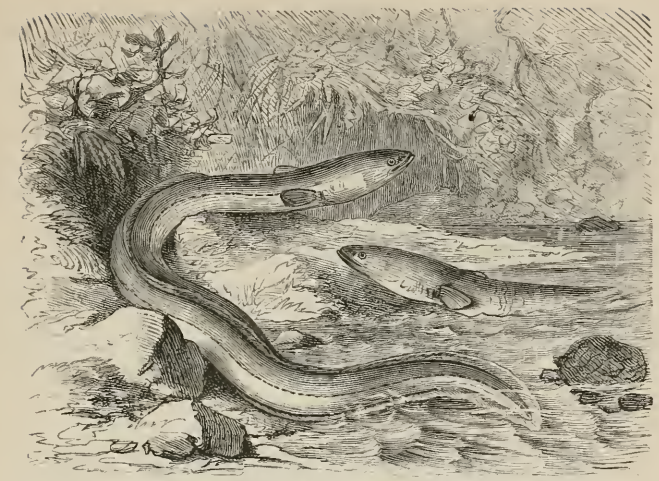


Diagrammatic view of Circulation of Fish. The impure, *venous*, trunks being in black; the pure, *arterial*, blood in outline. *A*, Auricle. *V*, Ventricle. *Ba*, Branchial artery. *a*, Branchial arches. *D*, Dorsal aorta. *R*. Return vein, or post cava. *H*, Net-work in liver.

The Bony Fishes have the supporting skeleton hardened by the deposition of lime; the gills, which are usually four on each side, covered, as in the immediately previous class, by a bony flap, or *operculum* (ō pĕr′kū lŭm). The scales are horny. The fins are supported by rays, and are without fulcra; and the caudal is always equally lobed (homocercal) (hō mō sĕr′kăl). The species are essentially oviparous. In this class are included nearly all the common fishes.

The adaptability of different species of this large class to their varied surroundings, presents a patent illustration of the perfection of Nature's workmanship. Some species inhabit the ocean, lakes, ponds, rivers, and even subterranean streams and pools in caverns. Myriad in variety, each species has its own swimming mechanical features, as clearly distinguishing and compelling *its* peculiar movements, as the varied configuration of bone and muscle in denizens of the land and atmosphere, gives to each species a different gait, or mode of flight.

FIG. 162.



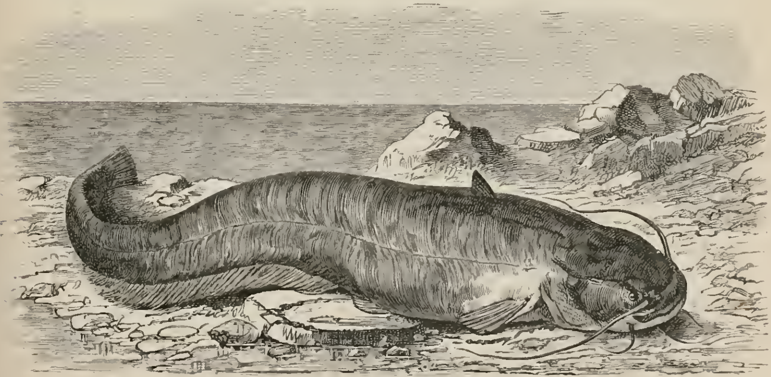
An guĭl′ la vŭl ga′ ris. Broad-nosed Eel.

ORDER APODES (ăp′o dēz).

The common *Eel* is so tenacious of life as to live for hours removed from water, and is said even to wander across dewy meadows from pond to pond.

The *Sly Silurus*, confined to Central and Eastern

FIG. 163.



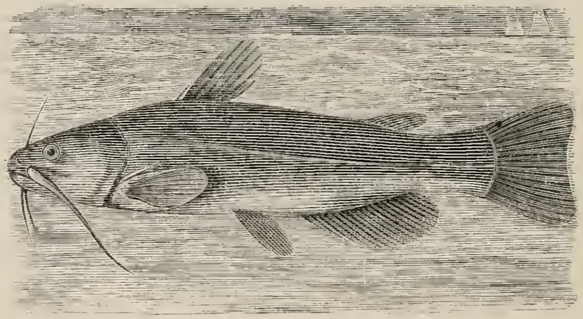
Sĭ lū′ rus gla′ nis. Sly Silurus (Reduced.)

Europe, sometimes attains the weight of three hundred pounds. As indicated by its name, it hides itself on muddy bottoms, and is warned of the approach of its prey by means of its barbels. Its voracity may well give it the name of the "shark of fresh waters."

ORDER NEMATOGNATHI (nĕm a to nā′thī).

The **Cat-fish,** or **Horned Pout,** has a naked skin, and the mouth surrounded by eight barbels. The dorsal and pectoral fins are each armed with a sharp spine, producing painful wounds, either from a poison-gland at their base, or from the insertion into the wound of a slime with which their bodies are always covered. Of the twenty-five well-known species, the largest is the great *Mississippi Cat-fish*, which often exceeds the weight of one hundred pounds. In the spring, the adults are said to lead the young in great schools near the shore, caring for them after the manner of a hen caring for her chickens. The great tenacity of life on removal from water of all the different species is almost exceptional among fresh-water species.

FIG. 164.

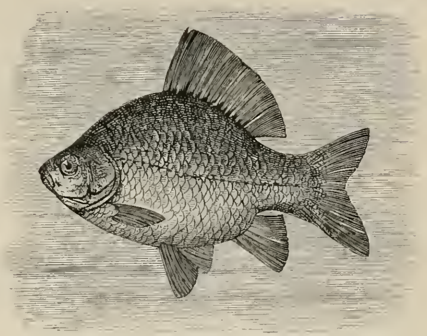


Am ī ū′ rus nĕb ŭ lō′ sus. Cat-fish, or Horned Pout. ($\frac{1}{3}$.)

ORDER EVENTOGNATHI (e vĕn to nā′thī).

The **Gold-fish**, originally from China, and of a greenish hue, has become a common pet of the parlor and fountain,* and through domestication changes to a golden yellow, but constantly tends to revert to its native color. The Silver-fish is only a variety of the Gold, resulting from artificial treatment in aquaria.

Fig. 165.

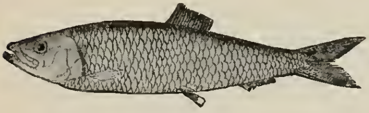


Ca răs′ sĭ us au rā′ tus. Gold-fish. ($\frac{1}{3}$.)

ORDER ISOSPONDYLI (ī so spŏn′dĭ lī).

The *Alewife*, or *Herring*, ascends fresh-water streams to spawn, thus coming each spring from the depths of the ocean to the hand of man. Immense schools go up the streams in which they were spawned the previous year, and always select the branches leading to certain head-waters, for which they have a preference.

Fig. 166.



Clū′ pĕ a ver nā′ lis. Herring. ($\frac{1}{10}$.)

The *Salmon* has habits similar to those of the Herring, but, on account of its greater size, is able to ascend waterfalls ten or twelve feet in height. Upon arrival at the spawning-ground, a hole is scooped in the gravel, and the eggs deposited and covered over, the parent then

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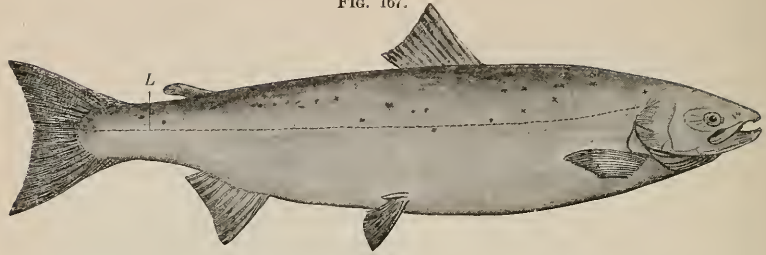
* Gold-fish should be fed once a week with some animal food, as worms, and more frequently with a stiff dough of flour and water.

Fig. 167.



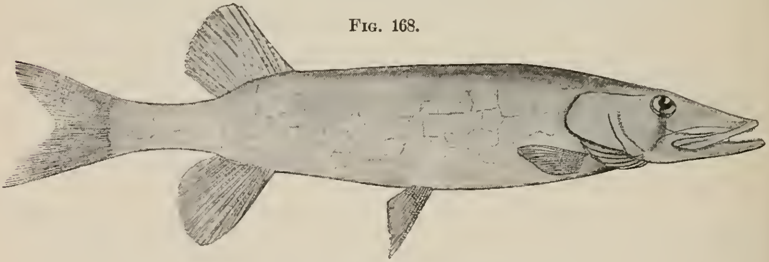
Săl′ mo sī′ lar. Salmon. *L*, Lever. ($\frac{1}{18}$.)

returning leisurely to the sea. Its food in the ocean consists of small animals, some of which may be its own progeny.

ORDER HAPLOMI (hăp lō′ mī).

The voracious American *Pickerel* [*Esox reticulatus*] (ē′sŏks rē tĭk ū lā′tŭs) is master of the waters in which it resides, destroying mercilessly every other fish and even the young of its own kind, as well as mammals and birds.* Hence they should be exterminated from all streams intended for the raising of trout, gold-fish, and other soft-finned fishes.

Fig. 168.



E′ sox re tic ŭ lā′ tus. Pickerel.

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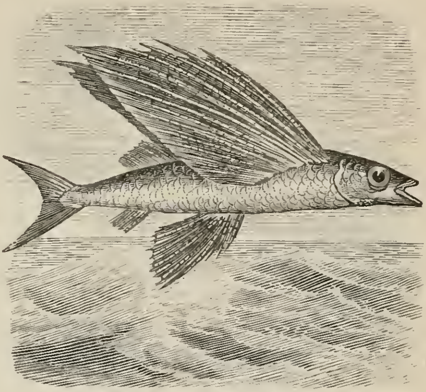
* A swan was perceived to keep its head under water longer than usual. Upon examination, it was found that a Pickerel had so far gorged its head as to kill both itself and the swan.

ORDER SYNENTOGNATHI (sĭn en to nā′thī).

The **Flying-fish** has large pectoral fins, by which it can support itself in the air for a few seconds.* Its brilliant coloring makes it the common prey of bird and fish.

Fig. 169.



Ex o cœ′ tus vŏl′ ĭ tăns. Flying-fish. (1/8.)

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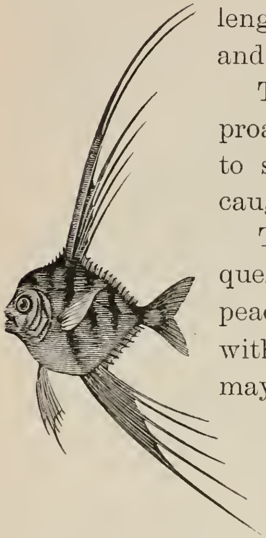
* This so-called "flight" is only the result of an impetus acquired by swimming to the surface with great velocity, in order to escape its enemies. It can not change its course, nor raise itself in the air, and its fins can not be flapped like wings, but serve only as a parachute.—Capt. Basil Hall gives a very animated description of the pursuit of a school of flying-fish by a dolphin (*Cō rў̆ phœ′ na hip pū̆′ ris*, Coryphene, note, p. 202). "The flying-fish took their flight to windward. A large dolphin, which had been keeping company with us abreast of the weather gangway, and, as usual, glistening most beautifully in the sun, no sooner detected our poor dear friends take wing than he turned his head toward them, darted to the surface, and leaped from the water with a velocity little short, as it seemed to us, of a cannon-ball. But though the impetus with which he shot himself into the air gave him an initial velocity greatly exceeding that of the flying-fish, the start which his fated prey had got enabled them to keep ahead of him for a considerable time. The length of the dolphin's first spring could not have been less than ten yards, and after he fell we could see him gliding like lightning through the water for a moment, when he again rose and shot upward with considerably greater velocity than at first, and of course to a still greater distance. In this manner, the merciless pursuer seemed to stride along the sea, while his brilliant coat sparkled and flashed in the sun. As he fell headlong in the water at the end of each leap, a series of circles was sent far over the surface, for the breeze—just enough to keep the royals and topgallant studding-sails extended—was hardly felt as yet below. The group of wretched flying-fish, thus hotly pursued, at length dropped into the sea; but we were rejoiced to observe that they merely touched the top of the swell, and instantly set off again in a fresh and even more vigorous flight. The direction they now took was quite different from the one in which they had set out, implying that they had detected their fierce enemy, who was gaining rapidly upon them. The greedy dolphin was fully as quick-sighted; for whenever they varied their flight in the smallest degree, he lost not the tenth part of a second in shaping his course so as to cut off the chase; while they, in a manner really not unlike that of the hare, doubled more than once upon their pursuer. But it

ORDER ACANTHOPTERYGII (ă kan thŏp te rĭj′ĭ ī).

FIG. 170.



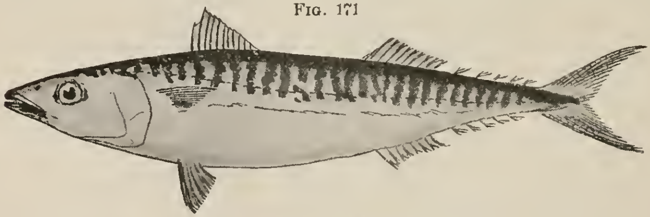
Blĕph′ ă ris cri nī′ tus.
Cobbler-fish. ($\frac{1}{4}$.)

The *Cobbler-fish* is noticeable for the lengthening of the spines of the dorsal and anal fins into hair-like filaments.

The *Mackerel*, in May and June, approach the shores in enormous shoals to spawn, and great numbers are then caught for market.

The great importance of the "Fishery question," so frequently straining the peaceful relations of the United States with its neighbors, the British Provinces, may be appreciated when we learn that, by the last census, the Mackerel fishery alone gave employment to more than twenty-five hundred men. The estimated expense of these fishermen for outfit and gear amounted to a sum in excess of half a million dollars, and the result of the fisheries nearly two million dollars.

FIG. 171

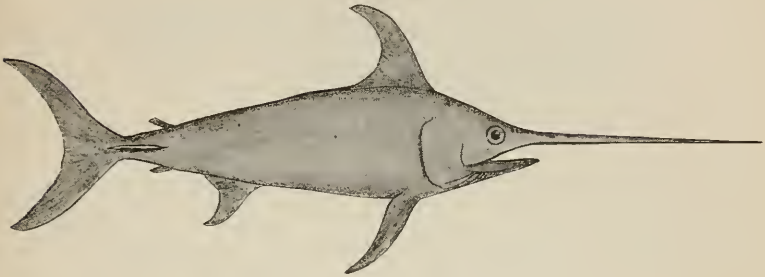


Scŏm′ ber ver nā′ lis. Mackerel. ($\frac{1}{9}$.)

was soon plainly to be seen that the strength and confidence of the flying-fish were fast ebbing; their flights became shorter and shorter, and their course more fluttering and uncertain, while the leaps of the dolphin seemed to grow more vigorous at each bound. Eventually this skillful sea-sportsman seemed to arrange his springs so as to fall just under the very spot on which the exhausted flying-

The *Sword-fish* is remarkable for its upper jaw, which is prolonged into a formidable weapon.* Rising beneath a school of small fish like the mackerel, and striking to the right and left with its sword, it kills great numbers and then devours them at its leisure. It is highly prized for food, fresh or pickled.

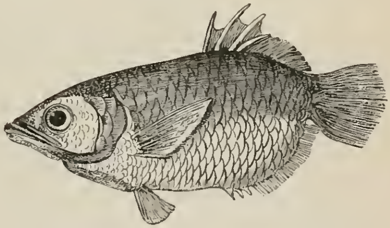
Fig. 172.



X̆iph′ ĭ as glā′ dĭ us. Sword-fish. ($\frac{1}{25}$.)

The *Archer* has been credited with the ability to shoot a drop of water from its mouth with such precision as to bring down a fly at the distance of two or three feet. A more careful study of the anatomy of its mouth shows no adaptation for such a feat, and doubt is thrown upon the tradition.

Fig. 173.



Tŏx′ ŏ tos jac u lā′ tor. Archer. ($\frac{1}{3}$.)

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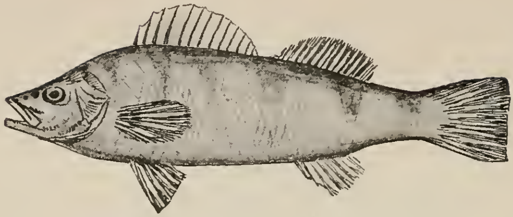
fish were about to drop. This catastrophe took place at too great a distance for us to see from the deck what happened; but on our mounting high on the rigging, we may be said to have been in at the death; for then we could discover that the unfortunate little creatures, one after another, either popped right into the dolphin's jaws as they lighted on the water, or were snapped up instantly after."

* Some species have a sword so strong that it has frequently been driven through the coppered hull of a vessel, a third of its length being sawed off on the inside.

Fig. 174.



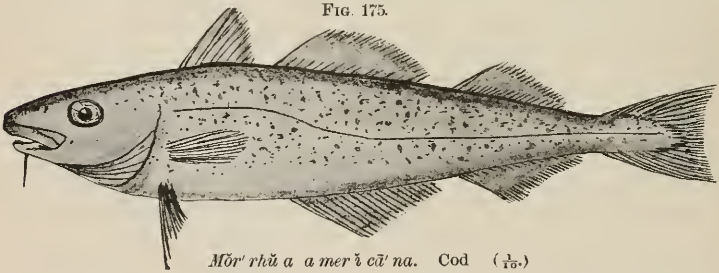
Pĕr′ca a mer ĭ cā′ na. Yellow Perch. ($\frac{1}{9}$.)

Perch are found both in salt and fresh water. They can be kept alive in the air for hours by occasionally pouring water upon their gills.

ORDER ANACANTHANI (an a kan thā′nī).

The **Cod** is caught in deep seas with hook and line. It is so numerous in certain localities that eight men have taken eighty score in a single day. Nine millions of eggs have been found in the roe of one female. The Cod holds the proud distinction of having the greatest economical value of any fish.

Fig. 175.

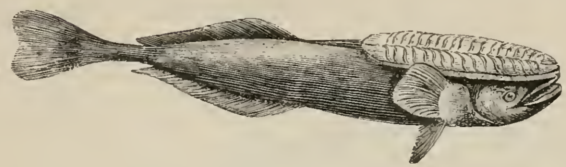


Mŏr′ rhŭ a a mer ĭ cā′ na. Cod ($\frac{1}{10}$.)

ORDER HETEROSOMATA (hĕt er o sŏm′ă tȧ).

The **Remora** (rĕm′ŏ rȧ), or **Suck-fish,** has on its head a flat disk, not unlike the sole of an India-rubber shoe. This enables it to cling to rocks, vessels, and even to other fish, twelve or fifteen having been found hanging to a single shark. The pressure of the atmosphere holds it so tightly that a strong man can hardly drag it loose. This arrangement probably serves it for cheap and easy transportation, as it is not a good swimmer.

FIG. 176.

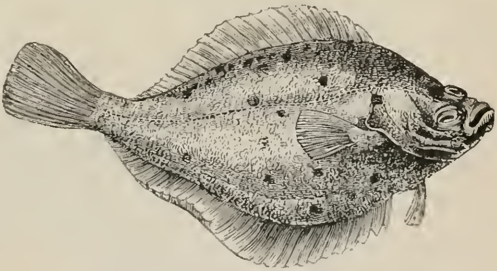


Ech ĕ nē′ is rĕm′ ŏ ra. Suck-fish. ($\frac{1}{7}$.)

ORDER DISCOCEPHALI (dĭs ko sĕf′a lī).

The **Flat-fish** is a remarkable illustration among the vertebrates of asymmetry. The young for some time swim vertically, with an eye on each side of the head. Gradually, the parts of head contiguous to one eye are twisted around, till in the adult state the eyes are both on one side, and that always the colored, or uppermost, side, as the fish settles to the bottom; the opposite side is usually uncolored. The number of species exceeds two hundred, those of the largest size being found in temperate and cold regions. The group furnishes important food fish, as the Halibut, Turbot, Sole, and Flounder; the first sometimes reaching a weight of four hundred pounds.

FIG. 177.

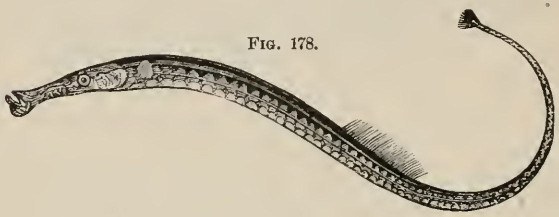


Pleū rŏ nĕc′ tes plă tĕs′ sa. Flat-fish. ($\frac{1}{12}$.)

ORDER LOPHOBRANCHII (lof o brăng′kĭ.ī).

The **Pipe-fish** has the jaws tube-like. The male has a kind of pouch, in which he places the egg for hatching, and thither the young flee for safety. It is a poor swimmer, moving slowly by means of the rapid action of the dorsal fin. It feeds upon minute insects and shell-fish, thrusting its long snout into crevices.

FIG. 178.

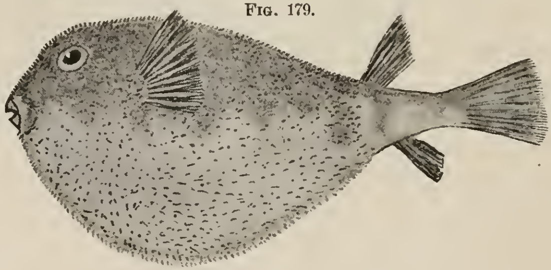


Sўn gnā′ thŭs pĕck i ā′ nŭs. Pipe-fish. (⅓.)

ORDER GYMNODONTES (jĭm nō dŏn′tēz).

Some of the varieties of this order have the skin armed with erectile spines. Each jaw possesses only a single tooth.

FIG. 179.



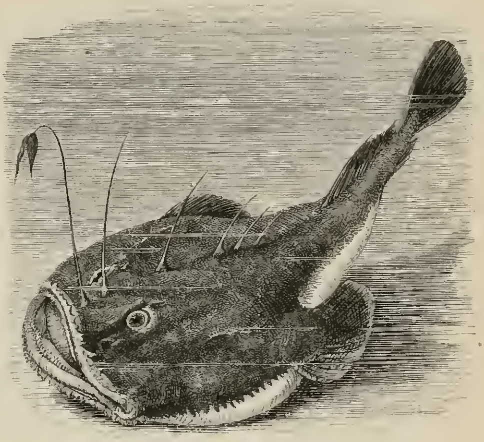
Cĭr rhŏs′ ŏ mŭs tûr′ gĭ dŭs. Swell-fish. (⅛.)

The *Swell-fish*, by rapid inspirations of air, when drawn out of the water, or by taking in water if within it, can swell its body to enormous proportions.

ORDER PEDICULATI (pe dĭk ū lā′tī).

The **Fishing-frog** has the ventral fins forward of the pectoral. Upon the head are three spines: the first with a shiny membrane at the tip, fastened by a ring and staple joint, and able to move in every direction; the other two move only backward and forward. The sluggish creature, lying in the mud at the bottom of the water, is thought to attract the curious fishes by waving the first spine as a glistening bait, till, in a favorable position, the quick snapping together of the jaws ingulfs them in the capacious mouth.

Fig. 180.



Lŏph′ ĭ us a mĕr ĭ cā′ nŭs. **Fishing-frog.** ($\frac{1}{12}$.)

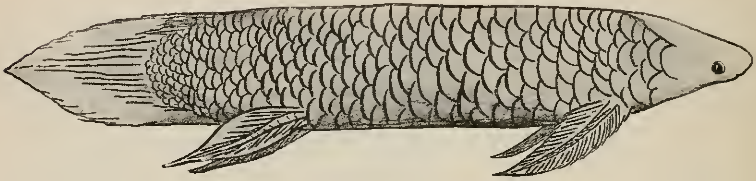
CLASS DIPNOI (dĭp′noi).

The members of this class are related more closely to the Ganoids (găn′oidz) than to the Teleosts (tĕl′ē osts), though inasmuch as in several particulars they resemble the members of the following class, their present position is justified. The body is covered with scales, while the skeleton is partially cartilaginous. The most important peculiarity is the lung-like structure of the air-bladder, which resembles the respiratory organ of the Batrachians.

ORDER MONOPNEUMONIA (mŏn o nū mō′nĭ ȧ).

The Australian *Ceratodus* (sē răt′ō dŭs) sometimes reaches a length of six feet, and is known habitually to leave the water and crawl about on land. It is prized by the natives for its flesh.

FIG. 181.



Ce răt′ ŏ dus fors′ tĕr ī. Barramunda.

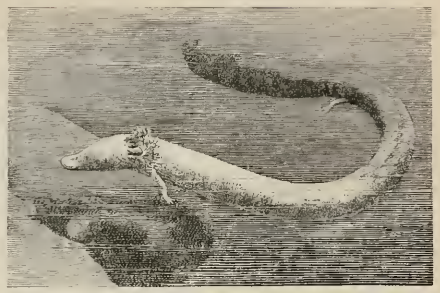
CLASS BATRACHIA (ba trā′kĭ ȧ).

We meet here with a most interesting class of vertebrates, the typical members of which in early life bear a strong resemblance to the fishes, though later on they change their character, losing their tails and having lungs take the place of gills. The animals now become terrestrial, but require moisture, as the naked skin, being well supplied with blood-vessels, is an important factor in blood purifying. The eggs, like those of fishes, are without a protecting shell, being generally deposited in the water. The BATRACHIA, as well as some of the previous forms, have the power of restoring lost parts, as the tail, or limbs. All are harmless to man.

ORDER URODELA (ū rō dē′lȧ)

To this order belong those Batrachians that have an elongated body, moist skin, and persistent tail, and usually four short limbs. The gills may be present through life, in the lower forms, though in the higher, they are generally resorbed, their function being performed by the lungs.

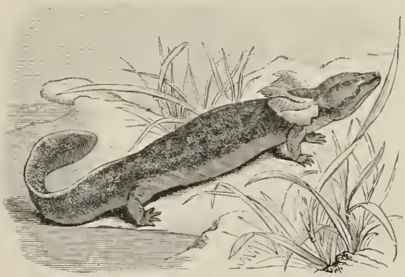
FIG. 182.



Prō' tē us an gui' nus.

The *Proteus* (prō′teŭs) of German caves has persistent gills, extremely small feet, and the eyes, which are of little use in a subterranean life, rudimentary. The long eel-like body enables it to swim rather than crawl.

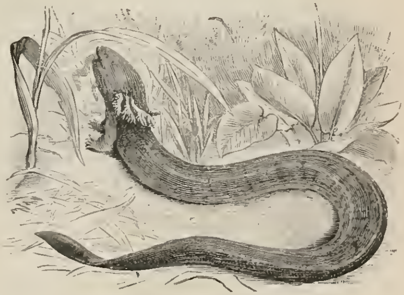
FIG. 183.



Nec tū' rus mac u lā' tus. Menobranchus.

The *Menobranchus* (mĕn o brăng′kŭs) of our western lakes and rivers is closely allied. This animal, unlike the Proteus, is highly colored, sees clearly, and has its feet comparatively well developed.

FIG. 184.

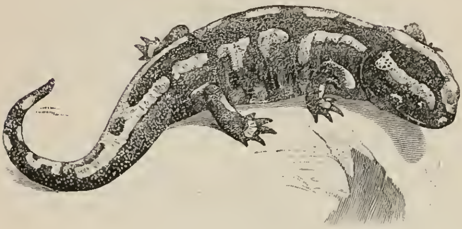


Sī' ren lac er tī' na. Mud eel.

The *Siren* (sī′ rĕn), or *Mud-eel*, of the more southern states, lacks the hind pair of limbs. It is of a deep blue color, and reaches a length of two feet. Its range is very extensive in the valley of the Mississippi.

The *Tiger Salamander* (săl a măn′der), found in the warmer states east of the Rocky Mountains, is peculiar, in that it retains its external gills so long as it is kept in water; but on being allowed to crawl on land, by the drying up of the pools, it soon loses its gills, breathing by means of lungs. As the Salamanders are without ribs, the air is forced into the lungs by the animal's filling its mouth, closing its nostrils, and then elevating its broad hyoid (hī′oid) bone.

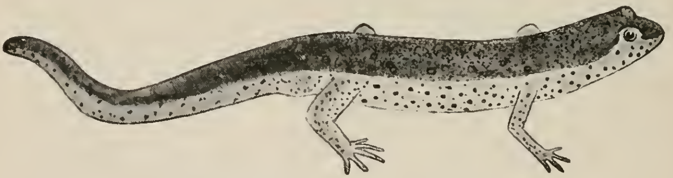
Fig. 185.



Am blў stō′ ma tī′ grĭ num. Tiger Salamander. (½.)

The common *Newt*, or *Triton* (trī′tŏn), is found in nearly every slow running stream, and is often confined in the aquarium, making a most interesting pet. If an adult be carefully examined, the scars left by the larval gills can be found on the sides of its neck.

Fig. 186.

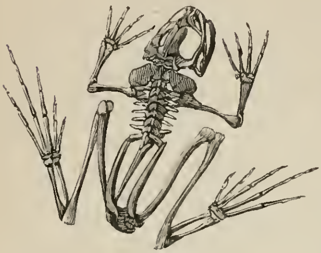


Dī e mўc′ tў lus vir i dĕs′ cens. Newt. (⅔.)

ORDER ANURA (a nū′rȧ).

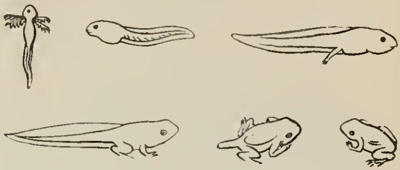
This order includes those Batrachians which in their growth have, as adults, not only lost their gills, but have resorbed their tails. The **Toads** and **Frogs** are familiar examples, and their metamorphoses have interested naturalists from the earliest times. The eggs, for instance, of a Toad, are deposited in some warm pool, where they hatch into small fish-like larvæ, provided with external gills, which have in the second stage disappeared; in the third, the hind limbs appear; in the fourth, the fore limbs; and, finally, the tail is resorbed, and we have the young *Toads*, which leave the ponds when the ground is moist, as after a shower, giving rise to the foolish notion that they rain down.

Fig. 187.



Skeleton of a Frog.

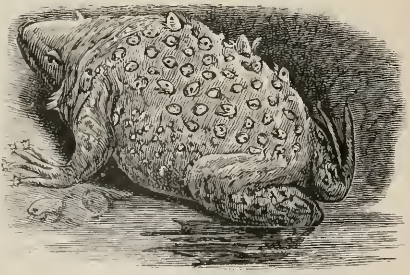
Fig. 188.



Tadpole changes.

The *Toads* are without teeth. A large form found in the northern part of South America, and known as the *Surinam* (sōō rē näm′) *Toad*, is at once the introductory, as well as, from its peculiar breeding habits, the most remarkable of the order. As soon as the slimy eggs are deposited, the male quickly places them upon the back of the female. Adhering to this, cells soon form around them, and each is covered by a lid. In these cells, the young go through their metamorphoses, until, finally, the covers are broken

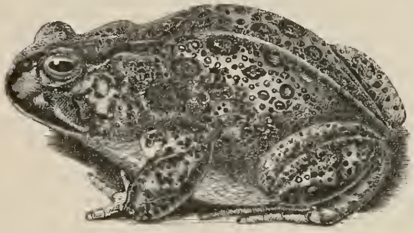
Fig. 189.



Pī′pa a mer ĭ cā′ na. Surinam Toad. ($\frac{1}{3}$.)

off, and they struggle forth. It is interesting to note that they are now much larger than were the eggs, and hence, must, while inclosed, have received nourishment from the body of the parent.

Fig. 190.



Bū'fo a mer ĭ ca' nus. Common Toad.

The common *Toad* so abundant about our gardens, living almost exclusively upon insects, and having a most voracious appetite, is to the gardener a most useful animal. After a shower, or during the evening, it sallies forth from its hiding-place, and by means of its viscid tongue it secures small insects so rapidly that only close observation can detect it in the act. The tongue, unlike ours, is attached in front, and free posteriorly; it is thrown over as it leaves the mouth, enabling the animal to reach to a considerable distance. The winter is spent in crevices, or in burrows, of their own construction, in sand banks.*

The *Frogs* differ from the Toads in that they habitually frequent the water, and are provided with teeth in the upper jaw; they are well adapted for their semiaquatic life. Their hind limbs are large and muscular, as they of necessity must be to work the broad webbed feet. The moist skin is also characteristic, being of use for respiratory purposes. Indeed, it is said that a Frog will live for more than a month with its lungs removed, but if the skin becomes parched, the animal will quickly die. The ears are large and prominent, being the drum-head-like membranes just back of the eyes.

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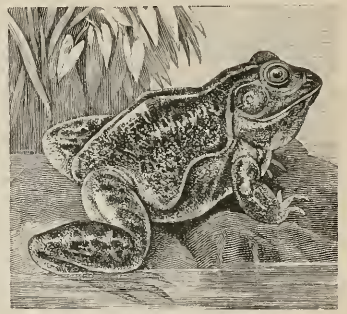
* No doubt they can remain a long time without food, but there is no well authenticated instance of their having been found inclosed in cavities of solid rock with no crevices connecting with the outside world. A naturalist once fed to a toad twenty-three squash-bugs and ninety-four caterpillars, each an inch and a half in length, before it turned away to digest its meal. Feeding mostly by night, the toad is of great aid to the Entomologist in furnishing him with specimens of insects he might otherwise never see; though he is compelled to sacrifice the life of his assistant in order to avail himself of its services. In spite of popular prejudice against handling toads, etc., all the members of this order are perfectly harmless, except a temporary smarting that the exudations of the skin may produce if transferred from the hands to the eyes.

During the warmer months, Frogs are often to be seen sunning themselves on some bank, but always on the alert for any passing insect, which they seize, as do the Toads, with their extensible tongues. The *Bull-frog* is not always content with an insectivorous diet, but will attack young ducks, and, in a fit of hunger, may even swallow one of its companions, possibly its own offspring. Winter is spent either in the mud of the pond, or in some crevice in the turf, whither the animal crawls and becomes covered by the decaying leaves.

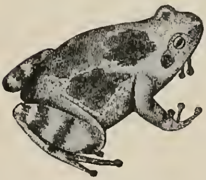
Fig. 191.



Rā' na ca tes bi ā' na. Bull-frog. (¼).

The *Tree-frogs*, living an arboreal life, have the tips of their toes provided with sucking disks, by the aid of which they secure themselves to the leaves and twigs among which they feed. In the spring, however, they take to the water, where they deposit their eggs, and the young pass through the tadpole stages. These are the frogs that make the spring and summer evenings vocal, especially when it rains, with their loud clear trill.

Fig. 192.



Hy̆' la ver sĭc' ŏ lŏr.
Tree-frog. (½.)

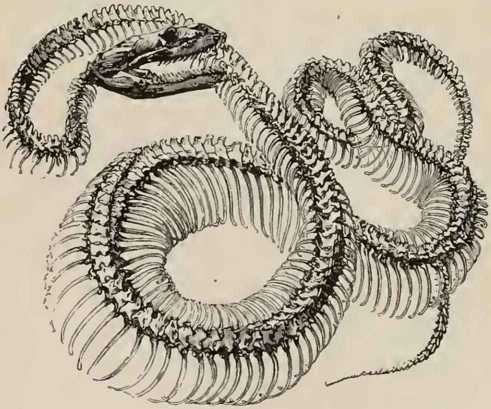
CLASS REPTILIA (rĕp tĭl′ĭ ȧ).

The members of this class have the body scaled, and the toes, when present, provided with claws. The development lacks the metamorphosis so characteristic of the previous class, the young generally hatching from a large egg, which is surrounded by a tough membrane, if not by a calcareous shell. A few forms are ovoviviparous (ō vō vī vĭp′a rŭs), the young being born. The class includes animals having the most diverse habits, and consequently, those possessing great variety as to form and general structure. All are air-breathers.

ORDER OPHIDIA (ō fĭd′ĭ ȧ).

The **Ophidians** are without feet, and though the pelvic arch may in some forms bear rudimentary appendages, all trace of pectoral limbs has disappeared. They are, however, able to progress with great rapidity by a wriggling motion of the body, together with the pushing of the large ventral scales, each of which is fastened to a single pair of ribs. The jaw-bones are but loosely attached together, and to the skull, and allow great, though limited, distensibility of the mouth. The tongue is bifid (bī′fĭd), and

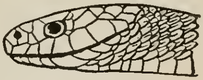
Fig. 193.



Skeleton of a Serpent.

is used as a tactile (tăk′tĭl) organ. Poisonous snakes have fangs, long lance-like teeth, occupying the anterior of the upper jaw. They are grooved, or tubed, leading from glands situate in the roof of the mouth and opening by a narrow slit at their extremity, that the poison, when they "strike," may be placed well into the wound. Though capable of feeling any unusual jar, as that made by an approaching animal, external ears are not present. The epidermis of serpents is shed at regular intervals, cleaving away from the lips at first, and being turned inside out as the animal leaves it. When the snake is in good health, the skin thus sloughed is entire, even the covering of the lidless eyes being intact. Though many serpents deposit their eggs, others, especially the poisonous forms, hatch the eggs in their own bodies, being ovoviviparous. The winter is passed in hibernation, several species congregating in the fall, and coiling together in a mass. All our more common snakes are quite harmless, being destitute of fangs, and of too small size to occasion any thing but fright.

FIG. 194.

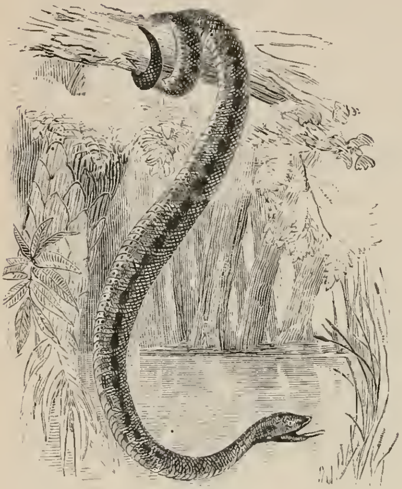


Eu tæ′ nĭ a sir′ tă lis.
Striped Snake.

The *Green*, *Striped*, *Black*, *Water*, and *Puffing Snakes* are also members of this harmless class, as is also the so-called "Adder."

The *Boas* of the New and the *Pythons* of the Old World, are also without poison apparatus. These are the largest Ophidians, though they seldom exceed a length of fifteen feet. They are found in the tropics, often near some pool, over which they suspend themselves, being aided in this by their rudimentary hind limbs, which appear at the base of the tail as a pair of spurs. When an animal, like a small dog, for instance, comes to drink, the reptile seizes and quickly wraps several coils of its body around it, thus crushing its bones and strangling it almost instantly. The process of deglutition (dĕg lu tĭ′shŭn) is now begun, the head being first seized by the snake, whose teeth, all pointing backward, and whose jaws successively and alternately pushed forward and drawn back, thus actually pull the snake over the animal. It is an interesting fact, that the female Python (pī′thun), after depositing her eggs, coils herself around them, while the heat of her body increases and the eggs, like those of a hen, are incubated.

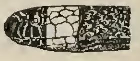
Fig. 195.



Bō′ ă ăn a cŏn′ da.

The *Coral Snakes*, of the more southern states, though generally inoffensive, are nevertheless armed with poison fangs, grooved rather than tubular. The East Indian *Cobra* (kō′brȧ) has a venomous bite, which is estimated to cause the death of 5,000 people annually. By means of elongated ribs, it expands, when irritated, a broad area on its neck, called the "hood."*

Fig. 196.



E′laps cor al lī′-na. Coral Snake.

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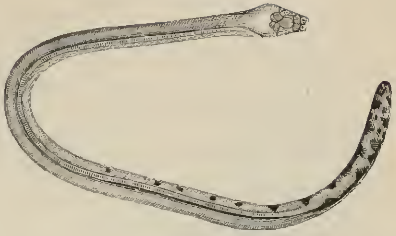
* A perfectly harmless snake, closely resembling the Cobra in general form, color, and habits, is often used by the so-called snake charmers, who of course handle it with impunity, pretending to throw it into a lethargy and bring it out at will. When the Cobra is used, it is probable that its fangs are first removed. "The reptile drawn from its cage, immediately swells its neck, extends its forked tongue, and begins to hiss. The charmer striking up a monotonous song, opposes his clenched fist to his enemy, which fixes its glittering eyes upon it and follows all its movements, thus keeping up a kind of dance."

The *Sea Snakes* inhabit the Pacific and Indian oceans, and are venomous, though, owing to the fact that when removed from the water they are incapable of seeing well, they are not considered dangerous. Living a pelagic life, their body is compressed and posteriorly forms a broad paddle-like tail.

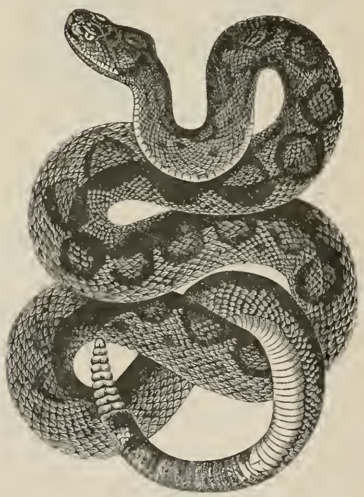
Fig. 197.



Sea Snake.

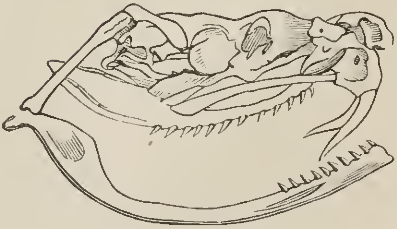
Rattlesnakes have on the end of the tail a series of horny enlargements, loosely attached to each other, which, when shaken, make a buzzing noise. Each slough may leave several new buttons, while the end ones are dropping off from wear; hence the number is no indication of age. The *Copper-head*, *Moccasin* (mŏk′kȧ sĭn), etc., are venomous snakes belonging to this family. They are more dangerous than the Rattlesnake, as they give no warning.*

Fig. 198.



Crŏ′ tă lŭs hor′ rĭ dus. Rattlesnake.

Fig. 199.



Skull of Rattlesnake, showing fangs.

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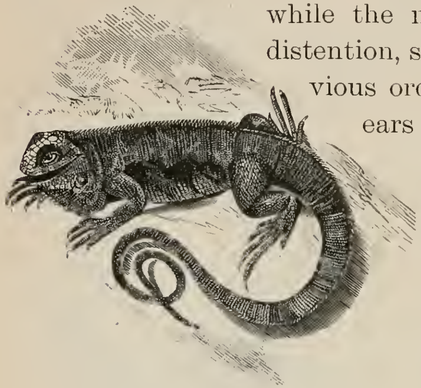
* On being bitten by an unknown snake, the wound should be examined, and if two large punctures are not found, there need be little apprehension. If it is found

ORDER LACERTILIA (lā sẽr tĭl′ĭ ȧ).

Fig. 200.

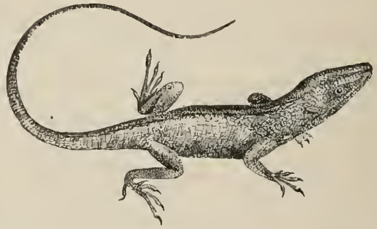


Ig ŭ ā′ nă tŭ ber cū lā′ ta. Iguana. ($\frac{1}{10}$.)

The **Lizards** are generally provided with two pairs of limbs, and the eyes with movable lids, while the mouth lacks the power of distention, so characteristic of the previous order. External evidence of ears is often exhibited by the tympanic (tĭm păn′ ĭk) membrane, as in frogs, or by deep pits each side of the head. With a single exception, the Heloderma (hĕl o dẽr′mȧ), all are perfectly harmless.*

The *Iguanas* (ĭ gwä′-nȧs) are arboreal fruit-eating Lizards, found in the West Indies and South America. They often reach a total length of five feet, and are much prized by the natives as food.

Fig. 201.



An′ ŏ lis prin cĭp′ ă lis. Southern Chameleon.

The "*Chameleon*" (ka-mē′lē ŭn) of our Southern States is much smaller. It is often seen sunning itself on old fences, on the leaves of the palmetto, etc. White

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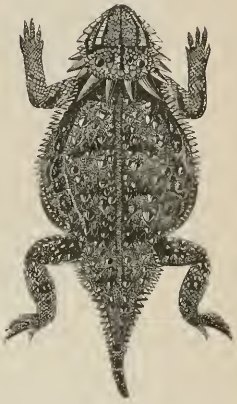
to show the marks of poison fangs, it should be sucked by a person whose mouth and lips are without scratches, the poison being harmless if taken into the alimentary tract. The wound should then be enlarged with a knife and again sucked. A tight ligature should be placed between it and the heart, and alcoholic drink administered, though not in large quantities.

* Though bearing a superficial resemblance to many salamanders, the Lizards are at once distinguished by their clawed toes, and, with a very few exceptions, scaly skin.

is the usual color of the under side; but the almost instantaneous change of color on the upper side, through varying shades of prismatic hue from dark brown to bright green as extremes, has given to this animal its common name in the localities it inhabits.

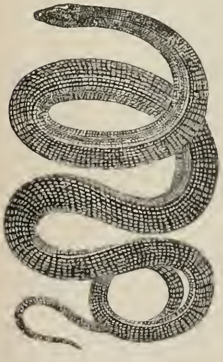
FIG. 202.



Phrў nŏs' ŏ mă côr nū' ta.
Horned Toad. (½.)

The *Horned Toads*, of which there are several different species, are found in abundance on our great Western plains, where their somber colors attract but little attention. They are in no wise related to the Batrachians, the misnomer being given through a general resemblance on the back to the coloration of the toad. Brought east, they are sometimes kept as pets, though the cooler climate often renders them semi-torpid and indifferent to their keepers.

FIG. 203.

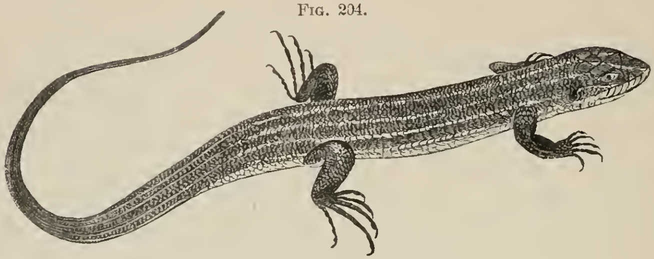


Oph ĭ sau' rŭs vĕn trā' lĭs.
Glass Snake.

The "*Glass Snake*" is a true lizard, though it is without feet. When irritated, it has the peculiar habit of breaking itself into two or more pieces; but these pieces do not form new individuals, nor do they come together again. While its enemy is seizing these fragments, the anterior part of the animal often escapes, finally reproducing the lost parts. It inhabits the Southern States.

The *Blue-tailed Skink*, inhabiting the more central parts of the Union, is often found secreted beneath the bark of some prostrate log, where it lies in wait for some insects. Above it is of a deep glossy green, ornamented with fine yellow lines, passing from the head to the dark blue tail.

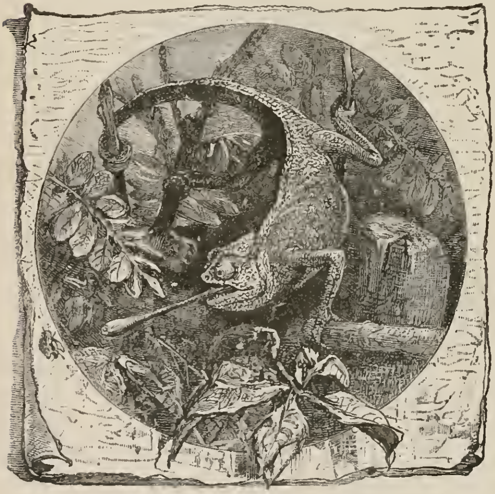
FIG. 204.



Eu mē' ces fas ci ā' tus. Blue Tail.

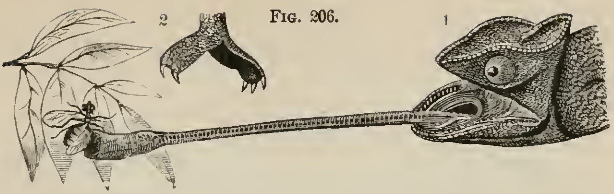
The Old World *Chameleon* is a most slow-going animal, meditating before each movement, and taking hours to travel the length of a short branch. It has many structural peculiarities. Its eye-lids, which cover the eye, admit light through a small hole placed in their center. The five toes of each foot are arranged anteriorly with three inside and two outside, while posteriorly the opposite arrangement obtains. The tail is long and prehensile, and the club-shaped tongue is capable of being quickly protruded to a considerable distance, the viscid tip serving to secure such insects as the animal may need for food.

FIG. 205.



Cha mē' lĕ ŏn vul gā' ris. Chameleon.

FIG. 206.



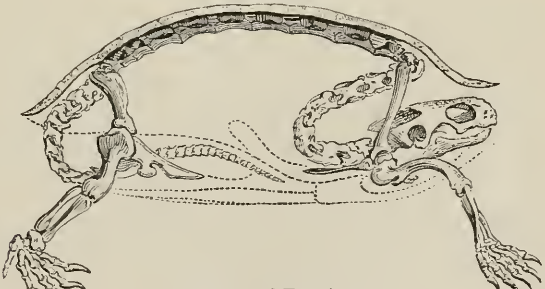
1, Tongue of Chameleon. *2*, Foot of Chameleon.

The Chameleon's power of changing color is remarkable, but its range of variation is much more limited than that of its namesake of our Southern States.

ORDER CHELONIA (kē lō′nĭ ȧ).

The members of this order bear a marked resemblance to one another. Every one knows a **Turtle.** The short, stout body is protected above by a more or less convex hard shell, the *carapax* (kăr′ă păks), formed by the expanded ribs and transverse processes of the dorsal vertebræ, and below by a flattened sternal plate, the plastron. From this shell the head and neck† extend anteriorly

FIG. 207.



Skeleton of Tortoise.*

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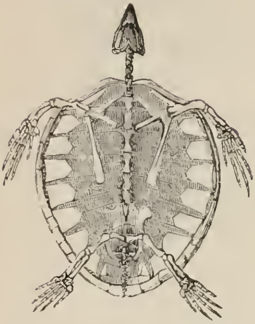
* The same number of pieces is found in the skeleton as in the ordinary vertebrates, the shape and size alone being changed.

† The long, slender muscles which move the flexible neck are tied to the under side of the carapax. When dried they may be capable of producing

and the tail posteriorly, while laterally are the two pairs of well developed limbs. The jaws, like those of a bird, are without teeth and are covered with horn.

Fig. 208.

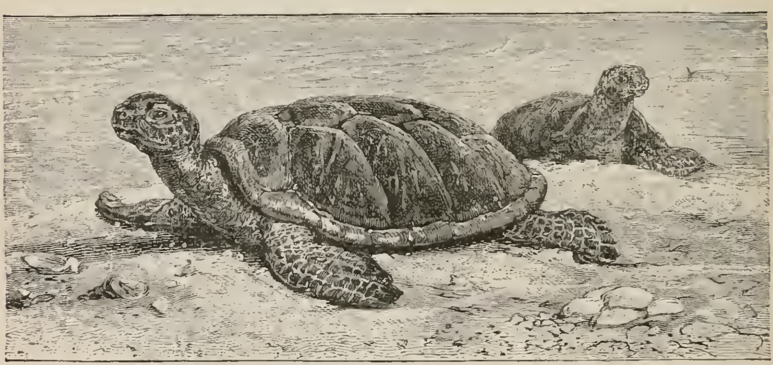


Skeleton of a Marine Turtle.

The *Sea Turtles* have the feet as broad flippers, adapting them for a pelagic life. At certain seasons, however, they visit the land to lay their eggs, which are deposited in large numbers, two hundred or more, in the sand.*

The *Green Turtle* is the most prized of the edible species, and its eggs are obtained in large quantities. Large sea turtles sometimes weigh a thousand pounds.

Fig. 209.



Che lō' nĭ a mȳ' das. Green Turtle. ($\frac{1}{30}$.)

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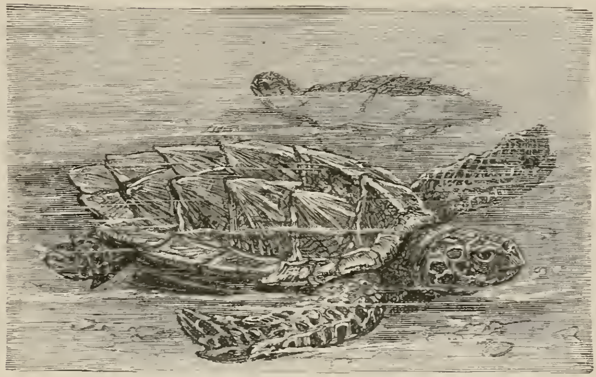
musical sounds, and thus have given rise to the poetical legend of the origin of the lyre.

* In the Antilles (*ăn tēl'*) and other breeding-places, the turtle is exceedingly valuable. Its eggs are a delicacy; its flesh is used for food; its fat for oil and butter; its carapax for drinking troughs, bathing tubs, canoes, and roofs to the native huts. The shell of some species constitutes the well-known tortoise-shell, a valuable article of commerce.

The smaller *Hawk-bill*, with the imbricated plates of its carapax, supplies us with the tortoise-shell of commerce. It is found in the warmer waters of the oceans of both the Eastern and Western hemispheres.

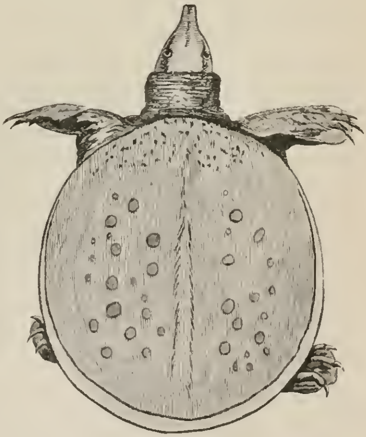
FIG. 210.



E ret mo chē' lys im bri cā' ta. Hawk-billed Turtle.

The *Soft-shelled Turtle* lives in our warmer ponds, though, from their retiring habits and their remarkable protective resemblance to their surroundings, they are seldom captured. The carapax is an exact counterfeit of a lily leaf as regards shape, flexibility, color, and venation. This form, like many others, can remain long below the surface, by drawing water into its pharynx, lined with appendages functionizing as gills. It is very ferocious.

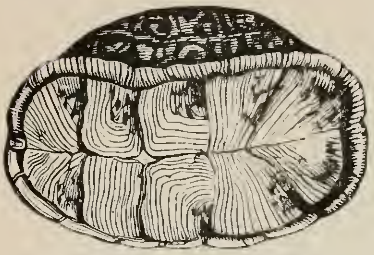
FIG. 211.



As pid o nĕc' les fē' rox. Soft-shelled Turtle

The *Land Tortoises* have feet formed only for walking, and hence they never enter the water. Their food consists of soft plants, as mushrooms.

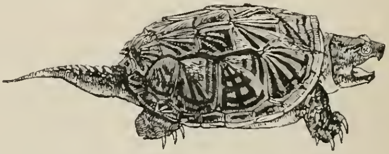
Fig. 212.



Cis tū' do vir gin i ā' na. Box Tortoise. (1/3.)

The *River Tortoise* is a common North American species. Its sharp-edged jaws are strong enough to bite asunder a stick half an inch in diameter. It is fond of water-fowl, swimming beneath the surface, seizing and quietly dragging them under. About June 10th, in the temperate climates, it lays thirty to fifty spherical eggs. For their reception, a hole is scooped in the sand by the hind feet, and then smoothed over and left. This entire work occupies but fifteen or twenty minutes. The eggs are hatched by the heat of the sun in about three months, when the young immediately take to the water.

Fig. 213.

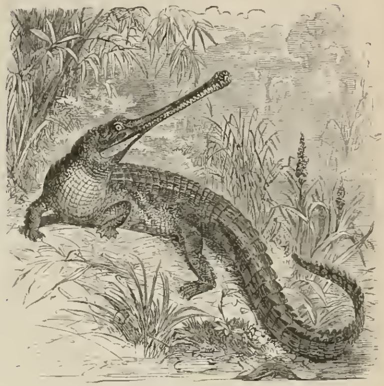


Chel' y̆ dra ser pen tī' na.
River Tortoise, " Snapping Turtle. (1/6.)

ORDER CROCODILIA (krŏk ō dĭl'ĭ ȧ).

The members of this order inhabit the waters of the warmer countries, and are of considerable size. The feet are powerful, armed with claws and formed for swimming, the digits being united with webs. The body is protected by a tough leathery skin, well supplied with hard bony plates. The eggs are deposited in a heap of mud and vegetable matter, which the mother collects, and are incubated by the heat generated through slow decomposition.

FIG. 214.

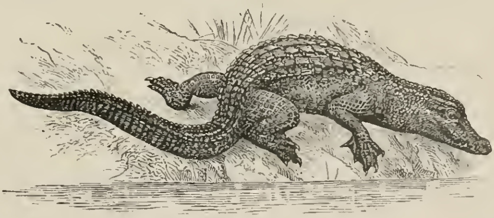


Ga vi ā′ lis gan gĕt′ ĭ cus. Gavial.

The *Gavials* (gā′vĭ alz) of India have the snout narrow and greatly elongated. In some localities, owing to the superstition of the natives, they are protected from destruction, and have become so numerous as to be dangerous to human life.

Species of *Crocodiles* are found in both the New and the Old World. The *Nile Crocodile* inhabits all the African rivers. In some localities it is ferocious, attacking the herdsman's cattle and sometimes even young children. It does some good, however, as it devours large quantities of decaying animal matter, that would otherwise pollute the water. Its snout is shorter and broader than that of the Gavial.

FIG. 215.

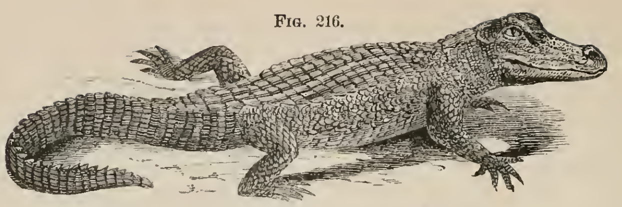


Croc o dī′ lus vul gā′ ris. Crocodile.

The *Alligator* has a snout still shorter and broader than that of the Crocodile.

Alligators are common in the swamps of our Southern

FIG. 216.



Al li gā′ tor mis sis sip pi ĕn′ sis. Alligator. ($\frac{1}{36}$.)

States, and have been captured on the Mississippi as far north as the mouth of the Ohio.

CLASS AVES (ā′vēz).

Though the blood of reptiles as well as of fishes is warmer than that of the surrounding medium, the active BIRDS have blood considerably warmer; and lest the heat should too rapidly leave the body, the scales take on a new structure, that of the feather. The blood is forced over the body by means of a four-chambered heart, the aorta (ā ôr′tȧ) passing to the right, rather than to the left as in man. The blood is purified in the lungs, branches of which, as air-sacs, are distributed to different parts of the body, some even penetrating the bones.*

The skeleton offers many important structural peculiarities. The head bears toothless jaws, and is articulated to the neck by but a single condyle (kŏn′dĭl). But the most interesting facts are those connected with the aërial (ā ē′rĭ al) life of the animal. The bones are light† and hollow, though of great strength. Those of the fore limb, bearing the strong feathers of flight, are highly specialized, and that these may be easily worked, large pectoral muscles are developed, attached on each side of the strong keeled breast-bone, where also they act as ballast. The other bones of the shoulder arch are stout and compactly fastened together; the clavicles (klăv′ĭ klz) joining anteriorly, to form the "wish-bone." The ribs and dorsal vertebræ are also more firmly joined than in other animals. In flying, the wing has a motion somewhat like the stroke of an oar; it strikes the air with the broad side, but, in returning, presents only the sharp edge. The flight offers a curious problem, to which as yet no satisfactory solution has been given. It is supposed that the upward pressure of the air caught in the saucer-like hollow of the wing can not bend the inflexible bone and muscles of the front margin, but curves the ends of the elastic quills upward, pushing them forward, and so forcing the bird ahead.

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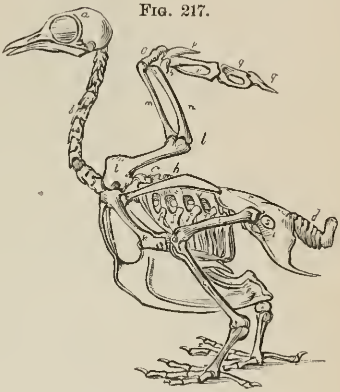
* It is said that a bird will breathe through the end of a broken bone when the windpipe is tied.

† This is owing to their being composed largely of phosphate of lime, and the marrow in many of them being replaced by air. Singularly, at one stage, they are solid, like those of all vertebrates, but the bony tissue is afterward absorbed. "The thinnest-walled and widest air-bone of the bird of flight," says Owen, "was first solid, next a marrow-bone, and finally became the case of an air-cell."

FIG. 217.



Skeleton of a Bird.*

The Plumage is a model of adaptation. The delicate filaments of a feather are covered with grasping barbs of a microscopic fineness. The under side of the wing feathers is concave, to resist an upward pressure. On the tail is a gland containing oil, with which the bird

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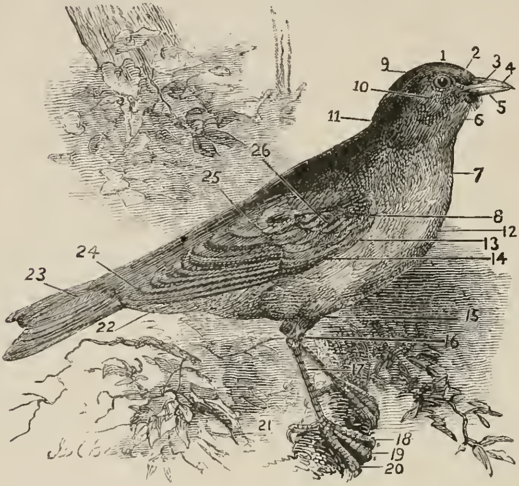
* The principal bones of the bird's skeleton are as follows: *a*, Cranium. *b*, Cervical vertebræ. *c*, Humerus. *d*, Caudal vertebræ. *e*, Sternum. *f*, Overlapping processes of ribs. *g*, Keel of sternum. *h*, Scapula. *i*, Ilium. *j*, Clavicle. *k*, Coracoid. (*l*, Elbow joint.) *m*, Radius. *n*, Ulna. *o*, Carpus. *p*, Single bone, representing one finger. *q*, Bones of a second finger. *r*, Bones of a third finger. (*s*, Opening in pelvis.) *t*, Femur. *u*, Fibula and tibia, below which is the upright tarsometatarsus, which is terminated by never more than four toes. The first toe is generally twisted round posteriorly; it has two joints. The second toe has three joints; the third, four; and the fourth, five.

FIG. 218.



Plumage of a Bird. 1, Crown. 2, Forehead. 3, Nostrils. 4, Upper mandible. 5, Lower mandible. 6, Throat. 7, Neck. 8, Spurious quills. 9, Occiput. 10, Ear. 11, Nape. 12, Breast. 13, Middle coverts. 14, Large coverts. 15, Belly. 16, Tibia. 17, Tarsus. 18, Inner toe. 19, Middle toe. 20, Outer toe. 21, Thumb. 22, Under tail-coverts. 23, Tail. 24, Primaries. 25, Secondaries. 26, Tertiaries.

preens its plumage and makes it water-proof. The whole plumage is renewed (molted) once, twice, or thrice a year. This molting process is never simultaneous over the whole body, but takes place gradually—corresponding feathers on both sides of the body dropping out together, and usually those not contiguous; so that the power of flight is never completely lost, or the guiding function of the tail entirely crippled. The normal coloration not being in many instances immediately assumed after molting, has often deceived, and led to the multiplication of species not warranted by more extensive observation. Indeed, matured plumage is often dependent upon several annual molts, while with some birds there is a seasonal plumage—a summer and a winter with parti-colored variations.

The distribution of the plumage over the body in tracts with most birds, permitting thereby ease of action and smoothness of the feathers under every variety of movement of the bird, is a remarkable feature, to which may be added *contrary* overlapping of the feathers of some certain sections, to likewise preserve smoothness under even twisting movements.

All birds are oviparous.*

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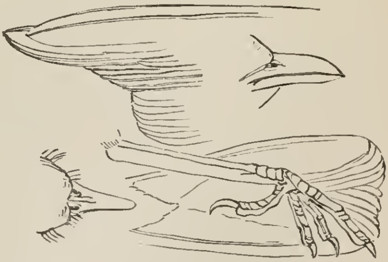
* Incubation varies according to the species. The temperature needed is 104° Fahr. The chick first pierces its shell by a pegging motion of the hardened point of the under mandible, and then enlarges the aperture by pressing with the knob-like tip of the upper mandible. This knob falls off soon after the chick emerges from its shell, as Nature abhors a useless appendage. Finally, by turning from left to right, it breaks the shell about half around, when a vigorous stretch of the body, assisted by a bracing with the feet, parts the shell transversely, and the young bird is liberated. Sometimes the fracture extends entirely around the egg, and the two portions are completely separated from each other. But if the inner membrane of the shell be not wholly divided, the connecting portion serves as a hinge, and the two parts of the shell may, in the movements of the young bird, become set, like two cups, one within the other.

The following is taken from Baird, Brewer, and Ridgway, as a specimen of what every thorough teacher will require from each of his pupils in writing, with simple sketches attached, for every bird that can be obtained in the immediate vicinity: "*Turdus migratorius* (tûr′dus mi gra tō′rĭ us) [*Robin*], American Redbreast. Tail slightly rounded; above olive-gray; top and sides of the head black; chin and throat white, streaked with black; eyelids and a spot above the eye, anteriorly white; under parts and inside of the wings chestnut-brown; the under tail-coverts and tibiæ white, showing the plumbeous inner portions of the feathers; wings dark brown; the feathers all edged more or less with pale ash; tail still darker, the extreme feathers tipped with white; bill yellow, dusky along the ridge and at the tip. Length 9.75; wing 5.43; tail 4.75; tarsus 1.25 inches. Habitat, whole of North America."

FIG. 219.



Sketch of principal parts of the Robin.

The CLASS may be divided into orders as follows:*

TABULAR VIEW OF THE CLASS AVES.

ORDERS.

- Terrestrial, incapable of flight, and consequently without keeled sternum. *Ratitæ.*
  - Of considerable size.... Toes, two or three.... ***Struthiones.*** Ostrich.
  - Of smaller size.... Toes, four.... ***Apteryges.*** Apteryx.
- Birds generally capable of flight; sternum always keeled. *Carinatæ.*
  - Ischium and ilium separated behind.... ***Crypturi.*** Tinamou.
  - Ischium and ilium united behind.
    - Upper part of crus (*tibia* and *fibula*)
      - not free, but inclosed within the skin of the trunk. Feet palmate. Bill
        - without lamellæ. Hinder toe
          - free or absent. Wings
            - unavailable for flight.... ***Sphenisci.*** Penguin, etc.
            - available for flight,
              - short, when closed scarcely reaching the tail. Legs posterior. ***Pygopodes.*** Loon, etc.
              - long, passing beyond base of tail. Legs at center of equilibrium. ***Longipennes.*** Gull, etc.
          - connected by membrane with inner toe, and nearly level with others. ***Steganopodes.*** Pelican, etc.
        - lamellate.... ***Lamellirostres.*** Duck, etc.
      - free as well as the lower part of the femur. Base of hinder toe or hallux
        - elevated above base of anterior toes. Inferior part of crus
          - naked; posterior toe sometimes wanting. Bill
            - usually short. ***Alectorides.*** Rail, etc.
            - long, stout and inflexible. ***Herodiones.*** Heron, etc.
            - long, and usually flexible and sensitive. ***Limicolæ.*** Plover, etc.
          - feathered; posterior toe rarely absent.... ***Gallinæ.*** Turkey, etc.
        - not elevated above the base of the anterior toes: the entire posterior toe insistent, rarely obsolete. Coverts of secondaries of first series
          - exceeding half the length of secondary quills. Toes
            - three anterior, and one posterior. Bill
              - without cere or hook. Generally naked at base, or with large, swollen skin above nostrils. ***Columbæ.*** Dove, etc.
              - covered with a cere at base, and with point of upper mandible hooked. ***Raptores.*** Falcon, etc.
            - two anterior, and two posterior, outer not versatile. ***Psittaci.*** Parrot, etc.
            - two anterior and two posterior, or three anterior and one posterior, with the outer anterior versatile. ***Picariæ.*** Woodpecker, etc.
          - not exceeding half the length of the secondary quills. Claw of the posterior toe not smaller than claw of the anterior middle one. ***Passeres.*** Thrush, etc.

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* The classification of Birds is unsettled. Ornithologists have not as yet agreed upon even the number of orders. Attempts have been made to establish

ORDER STRUTHIONES (strōō thĭ ō′nēz).

The members of this order being strictly terrestrial, lack several of the specializations characteristic of the great majority of birds, those which fly. The bones, with few exceptions, are unusually light; while the sternum, being unused as an attachment for muscles of flight, is small and weak. The clavicles are rudimentary. Though these birds, on account of their weight and the shortness of their wings, are unable to fly, they are all rapid runners. Their legs are long and powerful, being capable of extraordinary muscular effort. When running, they scarcely seem to touch the ground, and their speed is materially increased by the flapping of their stout rudimentary wings, which serve as balancers.

The two members of the order treated, are the *African Ostrich* and the *South American Ostrich.* Several other members, which undoubtedly excelled them in size, are now extinct.

The *African Ostrich* is the largest living bird. There is but one species, found in the interior of Africa, but rarely in Asia, except in Arabia. Its head is naked, and its short bill is somewhat broad and rounded at the point. Its long tarsi are covered with scales, and its

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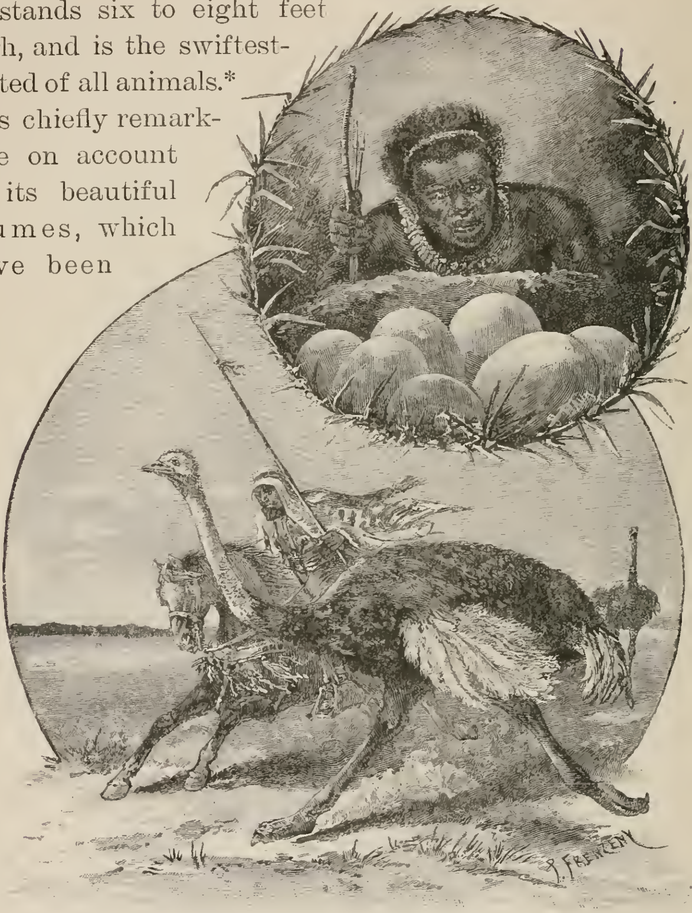
an ordinal system. Thus the form of the bill has been made a basis of separating the almost interminable series of Passerine (*păs′ ser īn*) birds into *Conirostres* (kō nĭ rŏs′ trēz), with stout, conical bill; *Dentirostres* (dĕn tĭ rŏs′ trēz), with a toothed and usually more or less hooked tip; *Tenuirostres* (tĕn ū ĭ rŏs′ trēz), with an elongated and awl-shaped bill; and *Fissirostres* (fĭs sĭ rŏs′ trēz), with a depressed, wide gaped bill. These distinctions have proved unreliable, and are generally discarded. In such uncertainty, the classification here adopted is essentially that of Lilljeborg (*lil je′ borg*) in "A History of North American Birds," by Baird, Brewer, and Ridgway. It is, however, considered only provisional. The sixteen orders given in the table have been subdivided by recent authorities into several hundred genera, and at least ten thousand species. The limits of this book will permit the description of only a few species typical of each order, American examples being generally chosen.

large femur bones with voluminous muscles. There are but two toes on each foot. It stands six to eight feet high, and is the swiftest-footed of all animals.* It is chiefly remarkable on account of its beautiful plumes, which have been prized as an adornment from the most ancient times.

Fig. 220.



Strūth'ĭ o ca mē'lus. African Ostrich.

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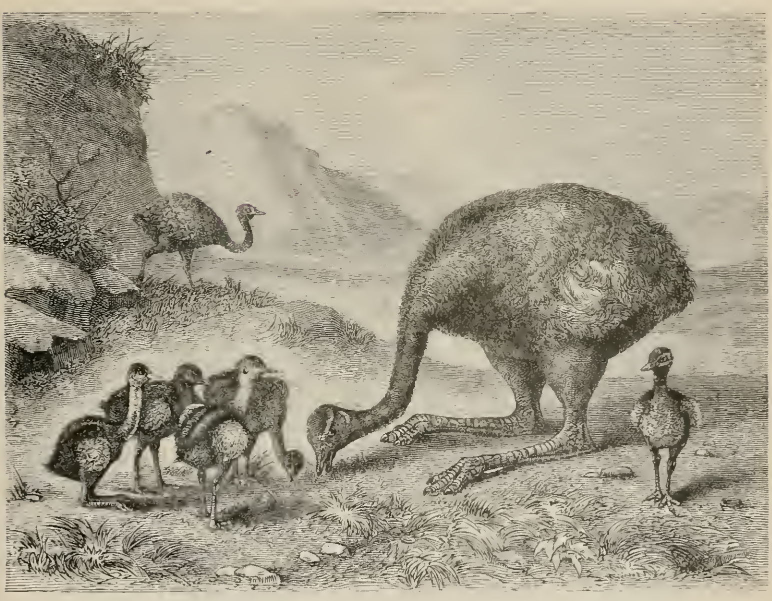
* The Ostrich will run thirty miles per hour. It is captured by the Arabs on their fleet steeds, only after a chase of a day or two, by several relays of horses and riders, and by pursuing in a straight line while the bird runs in a curve. One male accompanies two to six females, who lay in one nest. The hens

The *South American Ostrich** is only about half as large as the African, but is more completely covered

FIG. 221.



Rhē′ a rhē′ a. South American Ostrich.

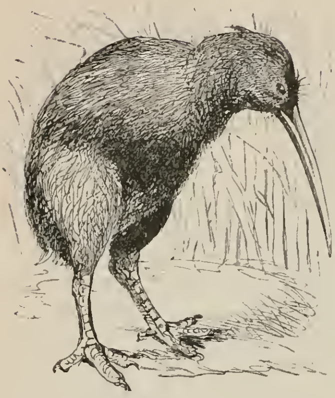
with feathers. It has three toes instead of two, and a large hooked spur on the wings.

take turns in sitting during the day, thus enabling the others to travel the long distances necessary to get food in that desert country, without leaving the nest uncovered. The male assumes the task of incubation at night, when his superior strength is needed to drive off prowling animals, which are sometimes found lying dead near the nest, killed by its powerful kick. As the young can not for some time go far, or digest the hard food of the old ones, the females continue to lay extra eggs for their nourishment. In this entire system of incubation, one can but see the nice planning of a Creator, fruitful in methods for meeting an end by varied means. An Ostrich egg is equal to two dozen of those of the domestic hen. It is cooked by placing one end in the hot ashes and stirring the contents with a stick till the omelette is roasted. In Cape Colony and California, there are now Ostrich-farms, where these birds are reared for their plumes.

* It is also polygamous, the females laying their eggs scattered at random, which the male collects into a nest, and then broods, hatches, and even tends the young.

ORDER APTERYGES (ăp tĕr′ĭ jēz).

FIG. 222.



Ap′ tĕr yx man tĕl′ li. Apteryx. ($\frac{1}{12}$.)

This order includes birds of one genus which inhabit the island of New Zealand. The feathers are hair-like. The nostrils, unlike those of all other birds, open at the extreme tip of the beak.

The **Apteryx** (ăp′tẽr ĭks), of about the size of a common hen, is nocturnal in its habits. The egg is very large, and is deposited in a hole scraped by the parent in the ground.

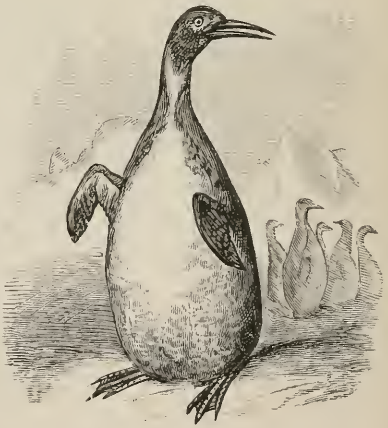
ORDER CRYPTURI (cryp tū′ ri).

[*See table for ordinal characteristics.*]

ORDER SPHENISCI (sfē nĭs′ kī).

The **Penguin** in its habits is half fish and half bird. It has paddle-wings, with short, rigid, scale-like feathers, disposed in regular order, and is incapable of flight. It uses its wings in swimming, by bringing them in motion alternately, while its feet answer for a rudder. Its bones are dense and heavy, with no apertures for the admission of air. It usually keeps

FIG. 223.



Sphe nĭs′ cus de mĕr′ sus. Penguin. ($\frac{1}{10}$.)

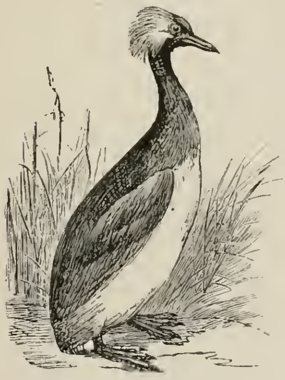
near the land, but seldom visits it, except for nesting. Whole companies then sit erect along the shore, where they might easily be "mistaken for a party of choristers with surplices and black gowns." The Penguin is confined to the colder regions of the South.*

ORDER PYGOPODES (pī gŏp′ŏ dēz).

The birds of this order have the tibiæ buried in the body nearly to the heel. This prevents walking, but favors swimming. Their feet are lobate or palmate, and their plumage is glossy.

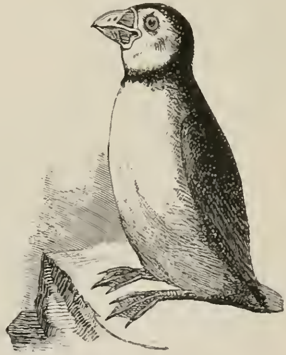
PYGOPODES.	FEET THREE-TOED, PALMATE.	Hallux absent.	*Puffin and Auk.*
	FEET FOUR-TOED, LOBATE.	Hallux lobate, free.	*Grebe.*
	FEET FOUR-TOED, PALMATE.	Hallux connected.	*Loon.*

FIG. 224.



Pod′ĭ ceps. Dobchick. ($\frac{1}{12}$.)

FIG. 225.



Fra ter′ cŭ la arc′ tĭ ca.
Puffin, Arctic Regions. ($\frac{1}{6}$.)

The *Puffin* and *Auk* † have three toes fully webbed, short wings, and a general adaptation to a purely aquatic life. On the land they sit upright. Most species pluck out feathers to bring their eggs into immediate contact with their flesh, for greater warmth during incubation. The Puffin drives rabbits from their holes, or burrows to the depth of two or three feet to lay its single egg, while the Auk deposits its two eggs upon a rocky shelf in the side of a cliff overhanging the sea.*

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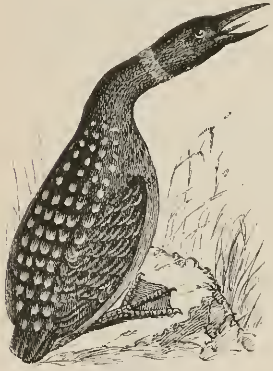
* The Patagonian Penguins are said to collect in such numbers at breeding-places as to cover thirty or forty acres. The ground is laid out in squares for their nests, as accurately as if a surveyor had been employed; stones are removed, streets made, a wall is thrown up on the windward side, and sentinels are posted.

† The Great Auk (*Al′ca im pen′ nis*) is said to have become extinct within the last half-century. A high value is placed upon the few specimens which have

FIG. 226.



Co ly̆m' bus tor quā' tus.
Loon. ($\frac{1}{12}$.)

The *Grebe*† (grēb) has its toes partly separate and flat, the edges being furnished with a broad, stiff membrane, making each one a paddle. On the land, it lies down and pushes itself along by its feet. In the water, however, it is perfectly at home, diving and using its wings in pursuit of fishes and aquatic insects.‡

The *Loon*, or *Great Northern Diver*, in its mature plumage of the fourth year, has few rivals in

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been preserved, there being now known only seventy-six skins and sixty-eight eggs—a skin being recently bought for the American Museum in New York for $625.

* The Puffin and Auk are confined to the colder regions of the North, as the Penguin is to those of the South.

† The Grebe, the Auk, and other aquatic birds, are a source of revenue to the people inhabiting the rocky coasts, which they frequent in multitudes. The nests are often built in the ledges of cliffs inaccessible from below, but the hardy fowlers suspend themselves by stout ropes from the summit of the precipices, and by swinging to and fro reach every cranny and crevice of the rock, gathering eggs and young birds. The calling is a perilous one. Often the rope chafes against a projecting edge of the rock, or vertigo seizes the fowler, or he reaches too far, or slips from his footing. The men holding the rope above hear a shriek of despair, and then all is still save the roar of the remorseless waves below.

‡ Singularly enough, the stomach of the Grebe always contains a mass of its own feathers, involuntarily swallowed probably, in dressing and cleansing its plumage.—One species makes a floating nest upon which it sits and hatches its progeny. But if disturbed, it plunges one foot into the water, and, employing it as an oar, transports its dwelling from the threatened danger.

beauty. Unable to move on land, except by a constant succession of awkward tumbles, in the water it is a rare swimmer and diver. Usually floating about half submerged, it can at pleasure settle down, showing only its head, or entirely sink, and, escaping with great swiftness, rise far distant.*

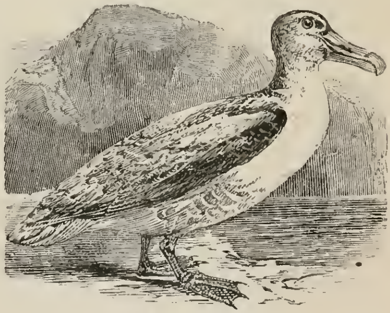
ORDER LONGIPENNES (lŏn jĭ pĕn′nēz).

The long-winged birds are distinguished by the size of their pointed wings and their palmate feet, with free, elevated hind toe. Generally oceanic, they rest upon the water, but do not dive.

LONGIPENNES.	NOSTRILS TUBULAR.	Hallux rudimentary, or wanting.	*Albatross.*
	NOSTRILS NOT TUBULAR.	Hallux small.	*Gull.*

The *Albatross* and *Petrel* are characterized by a hooked bill and long tubular nostrils. The *Wandering Albatross* is the largest sea-bird, having an expanse of ten to fifteen feet. Reposing on the surface of the water, with its head under its wing, it is often found a thousand miles from land.† Once elevated in the air, it seldom flaps its wings, and yet ascends or descends apparently without an

FIG. 227.



Di o mē dē′ a ex′ ŭ lans.
Wandering Albatross. ($\frac{1}{19}$.)

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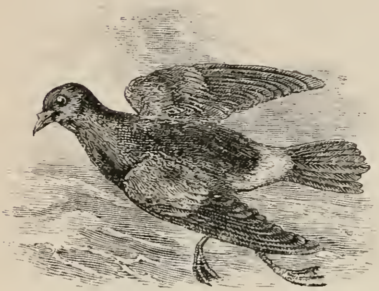
* Its cry is somewhat like the howling of a wolf, and is thought to portend rain.

† From a scrap of paper taken from an Albatross' neck by a sea-captain, and now preserved in the Museum of Brown University, it is conclusively proved that this bird, on one occasion at least, flew a distance between two points of 3,150 miles in twelve days.

effort.[*] The *Petrel*, sometimes called "*Mother Carey's Chicken*," is especially dreaded by sailors as the harbinger of a storm, but scientific observation has dispelled the illusion.[†]

FIG. 228.

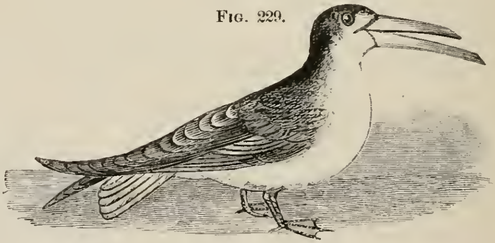


Thal as sĭd´ rŏ ma pe lăg´ ĭ ca.
Stormy Petrel. ($\frac{1}{3}$.)

The *Gulls* are cosmopolitan, and the true scavengers of the ocean.[‡]

The *Scissors-bill* has its long, lower mandible compressed laterally to the shape and sharpness of a knife-blade, while it shuts into the grooved edge of the short upper one. Darting swiftly[§] along, and cutting the water with its lower mandible, the smaller fishes struck by it, slide upward to the mouth and are immediately swallowed.

FIG. 229.



Rhўn´ chŏps nī´ gra. Scissors-bill. ($\frac{1}{5}$.)

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[*] It is found south of the equator, but there are other species on the western coast of North America.

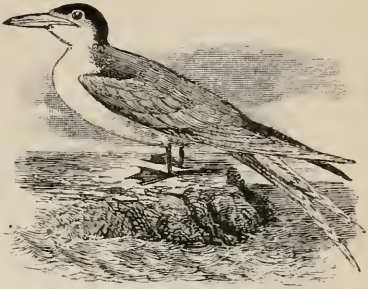
[†] Gleaning its scanty pittance from the whirling surges of the sea, and making its appearance in great numbers just before a storm, seeking food and shelter in the wake of the vessel, it has been charged with creating the tempest.—Its flesh contains much oil, and the natives of the Faroe Islands are said to make a lamp by drawing a wick through the body of a very fat one, and lighting the end which projects from the beak.

[‡] The different species vary greatly in coloration of plumage—white with various shades of black predominating. But most remarkable are the varying hues of the same individual at different seasons of the year, and at different ages, making identification often very difficult.

[§] In the swiftest swallow, the expansion of wing is twice the length of body; in the Scissors-bill it is much greater, hence more powerful.

The *Tern* has long, pointed wings, a forked tail, and slender, straight bill. The graceful evolutions of this "Swallow of the Sea," as it skims over the water and occasionally darts headlong beneath the surface, are a perpetual delight to the observer.

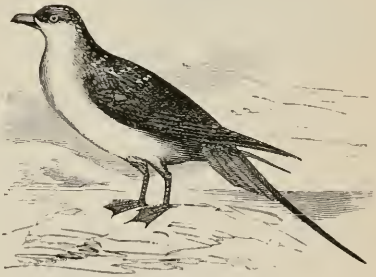
FIG. 230.



Stẽr′ na wĭl′ sŏn ī. Wilson's Tern. ($\frac{1}{7}$.)

The *Skua* (skū′ȧ) is remarkable for its stout, cered bill, hooked upper mandible, and piratical habits. It will even pursue birds of its own family, and force them to give up their booty; and when they have done so, it will swoop down with the velocity of an arrow, and catch it before reaching the water. Eggs and small birds are also often a part of its diet, proving how well it merits the common appellation given it by fishermen as the "teaser."

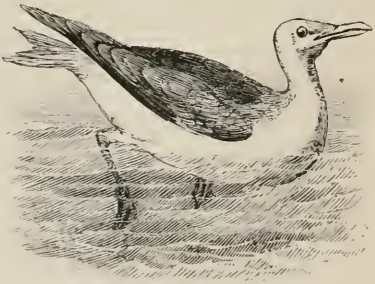
FIG. 231.



Stẽr co rā′ rĭ us par a sĭt′ ĭ cus.
Arctic Skua. ($\frac{1}{10}$.)

The *Great Black-backed Gull* will stand as a type of the many species which inhabit the Atlantic coast. It feeds principally upon fish, though sometimes upon small birds or quadrupeds.

FIG. 232.

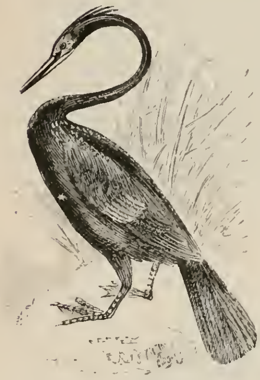


Lā′ rus ma rī′ nus.
Great Black-backed Gull. ($\frac{1}{12}$.)

ORDER STEGANOPODES (stē găn o pō′dēz).

The foot-covered birds are readily recognized by the totipalmate feet and unfeathered gular pouch—a sac beneath the bill sometimes holding a gallon, and used for a temporary larder.

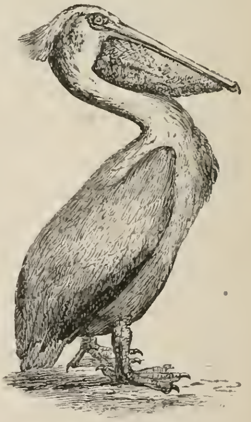
FIG. 233.



Plō′ tus an hin ga.
Snake-bird, or Water-turkey. ($\frac{1}{12}$.)

The *Snake-bird* is found throughout our Southern coasts. It is adapted to catching its prey under water, either by impaling upon its sharp, pointed beak, or by seizing between its serrated mandibles. Its favorite position is just above the water, into which it drops head first, so quietly as to make scarcely a ripple. Swimming beneath till it finds tufts of reeds, perhaps a thousand feet away, it shows at the surface only its bill and eyes, as it reconnoiters the neighborhood. The crimped tail-feathers serve as a rudder, but the wings are not used in swimming.*

FIG. 234.



Pel e cā′ nus fŭs′ cus.
Brown Pelican. ($\frac{1}{18}$.)

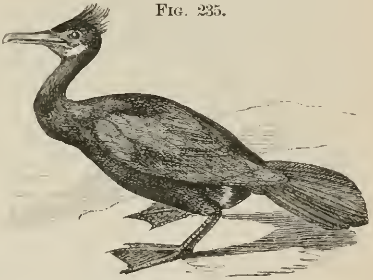
The *Brown Pelican* flies ten to twenty feet above the surface, watching the shoals of fish beneath, till a chance offers, when it falls flatwise, often with a force that immerses the whole body,* scooping up one or more with its pouch. Then rising, it repeats the operation as often as the capacity of its pocket will permit.

---

* Even before the young leave the nest, a parasitic worm is found in their stomach, which works its way to the brain, and there thrives in clusters of ten or more. Nineteen-twentieths of both young and adult specimens are thus infested, and yet are in apparently good health.

The *White Pelican* † swims upon the surface, darting down its long bill at the fish swimming near, till its pouch is filled, when it retires to the sand-banks and stands with its fellows in long rows, while the contents of the sac gradually pass into the stomach, as the process of digestion goes on.

FIG. 235.



Grăc' ŭ lus căr' bo. Cormorant. ($\frac{1}{12}$.)

The *Cormorant* ‡ (kôr′-mŏ rănt) pursues its prey under the water, using its wings to increase its speed. It is fond of eels, but often has a hard battle to keep one down, sometimes struggling for half. an hour, and then taking it to a rock and thrashing it till disabled. Its iris is bright green, and its plumage well oiled and glossy.

ORDER LAMELLIROSTRES (la mĕl lĭ rŏs′trēz).

The *Geese*, *Ducks*, etc., have palmate feet and lamellate bills, with corresponding laciniate processes on the sides of a fleshy tongue, ending in a horny tip.

---

* This dash upon the water would be fatal to itself if it were not for a thick layer of air-cells just beneath the skin, which breaks the force of the blow.

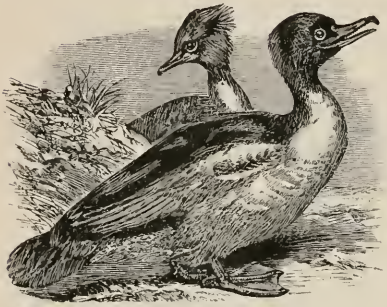
† The White Pelican (*P. e ryth ro rhy̆n′ chus*) ranges from Florida to the northwest coast. The Brown Pelican (*P. fuscus*), from the coast of North Carolina around to California. The former is remarkable for a horny excrescence on the top of the upper mandible, found in both sexes while breeding.

‡ Cormorants are abundant in all parts of the world, and by the Chinese are tamed and used for fishing, by placing a ring at the base of the neck to prevent the bird from swallowing the game.

LAMELLIROSTRES.	LEGS SHORT.	Tibia feathered.	*Duck.*
	LEGS VERY LONG.	Tibia mostly bare.	*Flamingo* (flă mĭng′ gō).

The *Ducks* have the legs short, with the hind toe separate, and the bill covered with soft, sensitive skin, and highly lamellated, to filter the ooze in which they feed. They are close-feathered, and keep the plumage well oiled, so as to dive without getting wet.

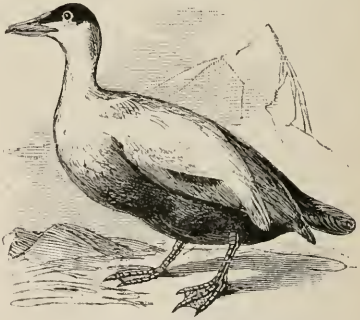
FIG. 236.



Mĕr′ gus a mĕr i cā′ nus. Goosander. ($\frac{1}{11}$.)

The *Goosander** has a narrow, cylindrical bill, with a saw-like margin, the teeth pointing backward, and the tip armed with a hooked nail. It may swim wholly submerged, seizing fish, whose very struggles force them more readily into the gullet of their captor.†

FIG. 237.



So ma tē′ rĭ a mol lĭs′ sĭ ma. Eider Duck. ($\frac{1}{10}$.)

The *Eider Duck* inhabits the Arctic regions, occasionally migrating to the middle Atlantic coasts.‡ The dark, rock-colored hue of the females is an excellent mimicry, and they will remain on the nest till trodden upon.

---

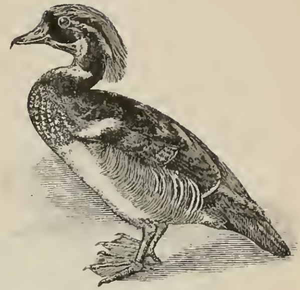
* This is one of the species of Ducks popularly called "Mergansers," or "Sheldrakes."

† Sometimes the fish is so long that the tail projects and it can be introduced fully into the stomach only after the head has been digested.

‡ It breeds upon the cliffs, and the down with which the female lines its nest has great commercial value. It is obtained by robbing it two or three times a season, the male at last supplying the deficiency from his own breast.

The *Wood Duck* nests in hollow trees, sometimes twenty feet above the ground, and six feet below the opening. For lining, it uses down from its own breast. As soon as the whole brood of twelve or fifteen are hatched, the mother takes them by the wing, or back of the neck, and depositing them on the ground, hastens with them to the water.

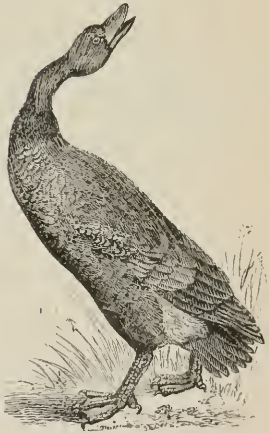
FIG. 238.



Aix spŏn′ sa.
Wood, or Summer, Duck. ($\frac{1}{10}$.)

The *Canada Goose* in the spring migrates in great numbers to the north to breed, and returns to the tropics in the autumn. It always flies in flocks, having the form of an acute angle, the leader falling back when fatigued, and the next one taking its place. The sexes may be distinguished by the greater length of the male's neck. They are monogamous, but are supposed to pair anew every spring.

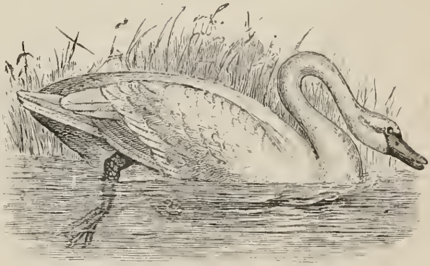
FIG. 239.



Ber′ nĭ cla can a dĕn′ sis.
Canada, or Wild, Goose. ($\frac{1}{20}$.)

The *Swan's** neck is in no proportion to the length of its legs, but is adapted to a swimmer that never dives, yet

FIG. 240.



Cy̆g′ nus buc ci nā′ tor. Trumpeter Swan. ($\frac{1}{40}$.)

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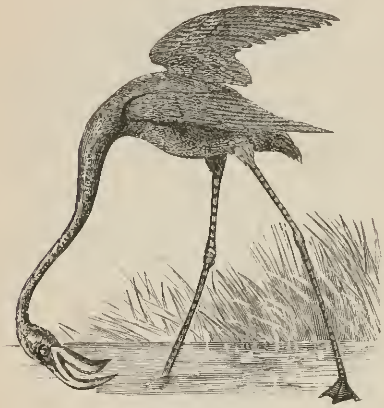
* The two species of Swans in America are easily distinguished, the *Cygnus buccinator* not having the orange or yellowish spot in front of the eye, which is so characteristic of *C. americanus*.

feeds upon aquatic roots. The stroke of its wing is powerful enough to fracture a man's leg. Swans fly high in their migration, to keep "the sky" of rapacious birds. They are said to live a hundred years.*

FIG. 241.



Phœ nī cŏp' tĕ rus rū' ber. Flamingo. ($\frac{1}{16}$.)

The *Flamingo*,† when feeding, lays the upper part of its bill next the ground, and with its feet stirs up the mud for small fish, insects, and seeds, which it secures by straining through its lamellæ.‡ Its plumage is a deep scarlet on the back, and roseate on the wings. Different observers since 1881, have exploded the old tradition of its building a hillock of mud as high as its body, and on the top making its nest and laying its eggs, its long legs hanging down on each side, and shown that it constructs a nest of mud only three or four inches high, and sits upon it like other birds.

ORDER ALECTORIDES (a lek tō'rĭ dēz).

This order includes forms quite diverse in structure and habits.

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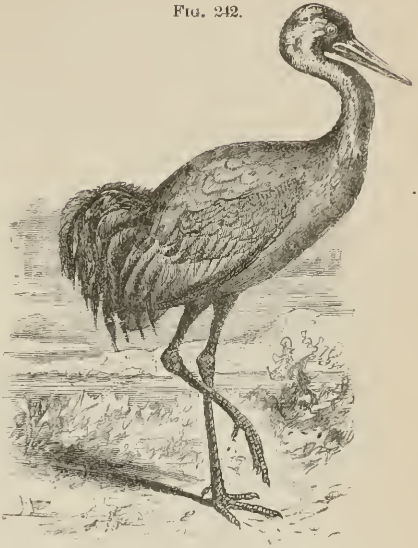
* Both species of the American Swan (see page 141) have similar convolutions of the trachea in the keel of the sternum, but the convolution of *C. buccinator* being more complex than that of *C. americanus*, renders its voice more raucous.

† The Flamingo, with its heron-like legs but full-webbed toes, eases the transition from the swimmers to the waders. So many of its characteristics are common to both, that it has been tossed back and forth from the days of Linnæus to the present, nor is it certain where it will be allowed to rest.

‡ Its tongue is very fleshy, and, during the days of Rome's extravagance, her gluttons were wont to parade a dish composed of Flamingoes' tongues.

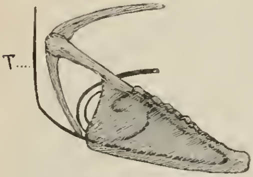
The *Whooping-crane* is principally confined to the Mississippi Valley. It seeks its food in the wild uplands, feeding upon insects and plants. About thirteen inches of the windpipe are twisted up in a hollow of the breast-bone, thus giving to the voice a sonorous, trumpet-like tone.

Fig. 242.



Grus a mĕr i cā' nus. Whooping-crane.

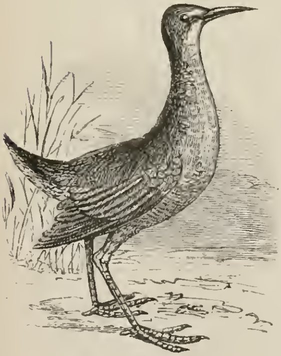
Fig. 243.



Trachea of the Whooping-crane.

The *Rails* have long, slender toes; a compressed body and short tail. Their nostrils are more or less pervious, giving them an acute sense of smell. Feeding in the marshes upon small snails and insects, they are protected from observation by their mimicry of the grassy tufts. The *Virginia Rail** is a type of the genus *Rallus*, which contains about twenty species.

Fig. 244.



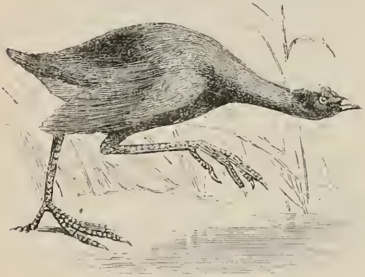
Răl' lus vir gin i ā' nus.
Virginia Rail. ($\frac{1}{4}$.)

---

* Except in being smaller, it is almost identical in form and color with *R. elegans*, thus showing the value of size as a specific and distinctive character. This latter species is rare in New England, where it is called "Mud-hen."

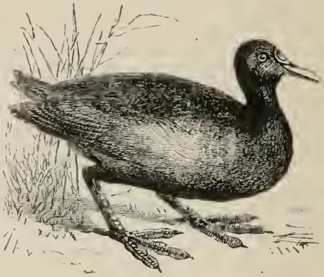
The *Purple Gallinule* (găl′lĭn ūl), abundant in the Southern, but accidental in the Northern States, has a rich and variegated plumage. It seeks its food of larvæ, weeds, and grains, upon the surface of the water only, its compressed body and large feet enabling it to thread its way among aquatic stems and to walk upon floating plants.

FIG. 245.



I o nŏr′ nĭs mar tĭn′ ĭ ca. Purple Gallinule ($\frac{1}{4}$.)

FIG. 246.



Fū′ lĭ ca a mĕr ĭ cā′ na. Coot. ($\frac{1}{7}$.)

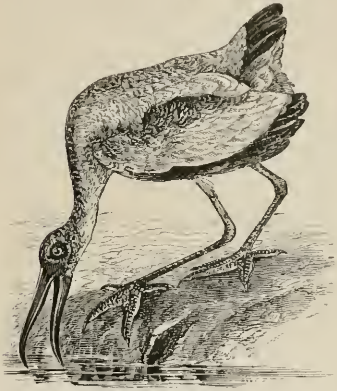
The *Coot*, having lobed feet, is adapted to an almost exclusively aquatic life, and hence, swimming and diving with great address, is seldom seen on the land.

ORDER HERODIONES (he rō dĭ ō′nēz).

The *Herons*, *Storks*, *Ibises*, etc., are generally of large size, with long, S-bent necks, and tufts of matted feathers (powder down) on both sides of the breast and posterior part of the body. The use of these singular patches is wholly a matter of conjecture. In flying, they double their neck and stretch back their legs. The latter serve as a rudder, their short tail being unfitted for this office.

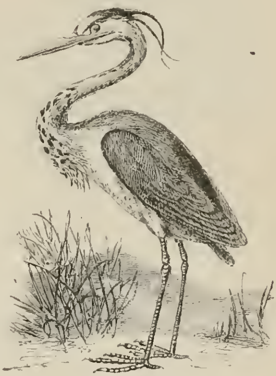
The *Ibis* inhabits all parts of the world, and some species migrate so irregularly as to be nowhere at home. Its long, arcuate bill is adapted to rooting in the mud in search of worms and small insects.* The *Wood Ibis* has a strong bill, with which it strikes the fish, frogs, young alligators, and snakes, that come to the surface on being disturbed by the bird's movements in the water.†

FIG. 247.



Tan′ tă lus loc ū lā′ tor. Wood Ibis. ($\frac{1}{18}$.)

FIG. 248.



Ar′ dĕ a her ōd′ ĭ as. Great Blue Heron. ($\frac{1}{7}$.)

The *Great Blue Heron* has a sharply-pointed, stout, conical-shaped bill, with which it pierces its prey as it approaches within length of its neck, while standing for hours on a hillock in motionless watchfulness. It is subject to great variations in plumage and measurements, and three species have probably been named for one.

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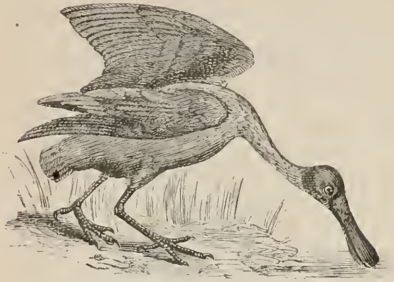
* The Sacred Ibis (*I. re lig i ō′ sa*) was venerated by the ancient Egyptians, probably because it rid them of serpents, the skins and scales of which have been found in the Ibis mummies. Some think, however, that the reason of this worship was merely because the coming of the bird was simultaneous with the annual overflow of the Nile, and hence symbolical of fertility. Whoever killed an Ibis, was mobbed while the dead bird was embalmed. The Ibis multiplied in consequence to such an extent as to impede travel in the streets. The affection of the bird for Egypt was so great that, according to Acteon (*ăk tē′ ŏn*), when taken away it died of home-sickness. But now, being killed and eaten by the modern inhabitants, who have abandoned the faith of their fathers, it has almost deserted the country.—FIGUIER.

† When a sufficient number of its victims lie floating around, it gorges itself, often leaving many untouched, and then, stationed on the margin of the stream, patiently awaits the process of digestion.

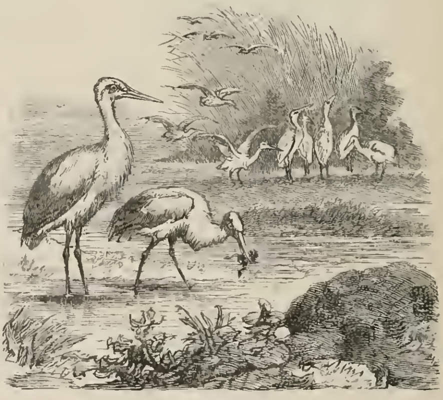
FIG. 249.



A jā′ja a jā′ja. Roseate Spoonbill. ($\frac{1}{15}$.)

The *Roseate Spoonbill* of the South, nearly extinct, is the only representative of this family in the United States. It breeds the second year, but does not attain its perfect plumage until the fourth or fifth. It is then a beautiful rose color, with carmine wing and tail-coverts, head naked with golden-yellow skin shading into glossy black around the top of the neck, and with patches of rich buff on each side of the breast and upper part of the tail.

FIG. 250.



Cī cō′ nĭ a ăl′ ba. White Stork.

The *White Stork* of Europe is exceedingly useful, feeding upon garbage and noxious creatures. It is easily tamed, and its sagacity is marvelous.* The regularity of its migrations has made it the subject of comment in all history, both sacred and profane.

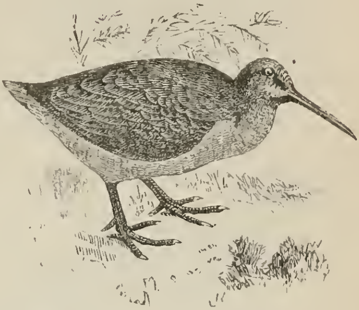
---

* A tame Stork has been known to join children playing hide-and-seek, run when touched and to distinguish the child whose turn it was to pursue the rest so well as to be on its guard along with the others. The Germans and Dutch esteem it a good omen when a Stork builds its coarse nest of sticks on their house-top. Innumerable stories are current among different nations, ascribing to the Stork gratitude, chastity, parental affection, conjugal fidelity, and filial piety. In the Tyrol, for example, a male Stork refused to migrate, and passed several winters with his mate, who, being wounded, could not fly.

ORDER LIMICOLÆ (lī mĭk′o lē).

The *Plover-snipes* have a long slender beak, without hard-cutting edges, and wholly or in great part membranous. Their narrow nostrils are placed low down, and entirely surrounded with soft skin.

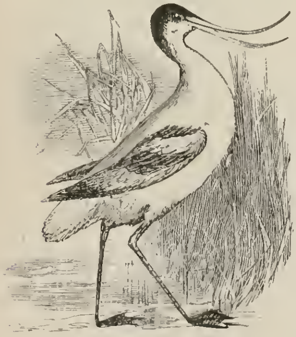
FIG 251.



Phil o hē′ la mī′ nor. Woodcock. ($\frac{1}{5}$.)

The **Woodcock**, representing all the *Snipe* family, has a long, grooved, flexible bill, well supplied with nerves to the end, that in probing deep into the bogs and moist turf, it may detect the worms and larvæ. Its upper feathers mimic well the herbage beneath it, and its eyes are placed so far back, that their range of vision meets behind the head, making it a wary bird.

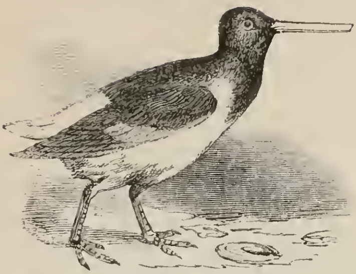
FIG. 252.



Re cur vi rŏs′ tra a mĕr i cā′ na.
Avocet. ($\frac{1}{8}$.)

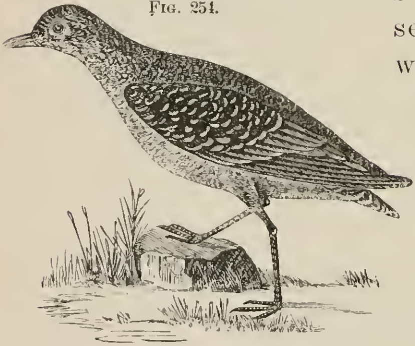
The *Avocet* (ăv′ŏ sĕt) possesses a recurved, flattened bill, useful for scooping up small fish and aquatic insects, as it sweeps the narrow runs, with a movement like that of a mower swinging a scythe. It breeds on the Atlantic Coast from Texas to Long Island, but most abundantly in the Southern States, and also in certain isolated localities in the interior of the Continent, particularly in Salt Lake Valley and in the neighboring basins. For a short distance it is one of the swiftest flyers.

FIG. 253.



Hæ măt' ŏ pus pal li ā' tus. Oyster-catcher.

FIG. 254.



Cha ră' drĭ us vir gĭn' ĭ cus. Golden Plover.

The *Oyster-catcher* of the Atlantic coast has a bill, long, abrupt, and chisel-like, adapted to opening the shells of bivalve mollusks and detaching limpets from the rocks.

The *Plovers* frequent commons and unsheltered shores, running around in search of insects, slugs, worms, etc. They change their locality several times in a single season, and are amongst those birds most eagerly sought by the sportsman. The *Golden Plover* inhabits all the continent of America.

ORDER GALLINÆ (găl lī'nē).

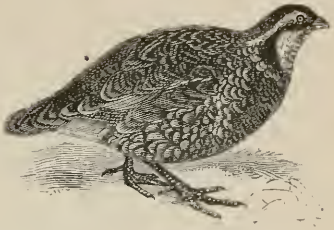
This order includes the hen-like birds. They generally have feeble powers of flight, characterized by a whirring sound. To aid them in scratching, the hind toe is elevated. Their food is first softened in a crop, then mingled with the drink in a second expansion of the gullet, and lastly ground in the gizzard. To elude the sharp eye of their enemies, they squat upon the ground and lie quiet—their mimicry corresponding to the herbage they frequent.*

---

* To this order belongs the Domestic Fowl (*Găl' lus ban kĭ' va*). The original stock, however, has been so modified by cultivation for thousands of years, that it can not be identified, though it is generally supposed to have come from India.

They are mostly polygamous, feeding in flocks of ten or twelve females to one male.

FIG. 255.

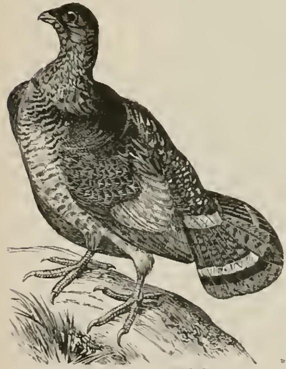


Or' tyx vir gin i ā' nus.
Bob-white, or American Partridge. ($\frac{1}{9}$.)

The *Partridge* is not migratory, but passes the winter in swamps.* It is monogamous, the young remaining with their parents till spring, and then pairing. At night, the whole covey roost on the ground in a close circle, their heads directed outward, in close watch for enemies.

The *Grouse* is distinguished by having the tarsi and the nasal groove partly feathered.† Not being migratory, it is hunted during the colder months. In the spring, it drums upon a log with its wings, closely imitating distant thunder. When the young are hatched, they follow the mother, and the males joining the flock, all remain together during the winter, after which they separate, the young selecting their own homes, not far from their parents. This species is in great demand and would quickly become extinct if unprotected by law.‡

FIG. 256.



Bonā' sa um bĕl' lus.
Ruffed Grouse. ($\frac{1}{9}$.)

---

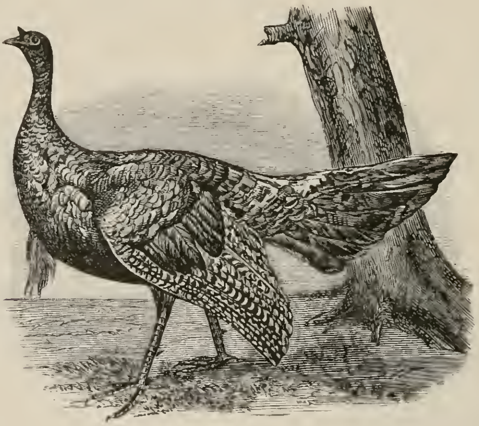
* In New England, the Partridges are called Quails. The true Quail (*Co tŭr'-nix com mūn' is*) is found in the Old World, and is migratory in habit, leaving Africa in the spring and returning from Europe in the autumn. Passing the Mediterranean in immense flocks, millions are captured as they alight upon the rocky islands.

† The Ruffed Grouse is called Partridge in New England and the West, and Pheasant in the Middle States.

‡ The Pinnated Grouse (*Cū' pĭ do cu pĭ dō' nĭ a*) is kindred to the *Ruffed*, and formerly abounded in New England, but is now limited to the prairies of the Western States, though shipped to the Eastern cities in the winter by the car-load.

The *Turkey* is indigenous to America. There is but one genus [*Meleagris*] (mĕl e ā′gris), with two species. One of these is the *M. ocellata* (o cel lā′ta) of Honduras, whose tail is enameled with blue "eyes," each surrounded by a ring of yellow and purple. The other species has two varieties, the *M. gallopavo* (găl lo pā′vo) and *M. mexicana* (meks ĭ cā′nȧ). The latter is the one from which the Domestic Turkey sprung. The Wild Turkey nests in some secluded spot, which it guards jealously, seldom approaching it twice by the same path, and luring the intruder away by various wiles. As soon as the young are hatched, the female takes them under her entire care, leading them long distances for food, and carefully avoiding marshes until her brood have exchanged their down for feathers impervious to water.*

Fig. 257.



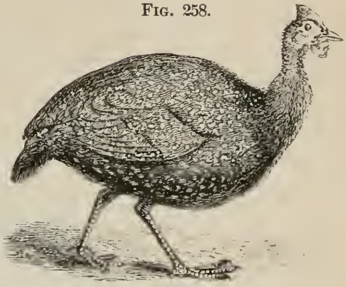
Mel e ā′ gris gal lo pā′ vo. Turkey. ($\frac{1}{15}$.)

---

* Turkeys are often captured in the following manner: A pen of logs is raised about four feet high. At one point, an entrance is dug underneath and corn sprinkled both without and within. The Turkeys greedily picking this up, enter the pen. Once entrapped, they vainly seek with elevated head to escape between the logs, but never think of stooping down to pass out where they entered.

The *Guinea-fowl* came from Africa. Its harsh, ringing cry makes the bird very useful in the poultry-yard as a protection from crows and hawks. From the fact that occasionally individuals in a brood develop a white breast, it is supposed there is a white variety, from which those purely white may have sprung.

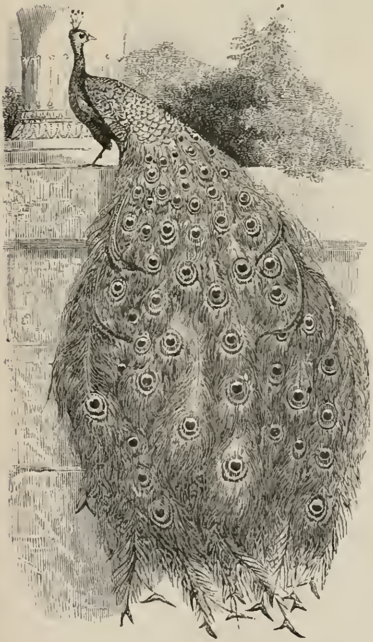
FIG. 258.



Nū'mĭ da mel e ā'gris. Guinea-fowl. ($\frac{1}{12}$.)

The *Peacock's* tail-coverts are decorated with eye-like spots. The true tail-feathers are short, unvariegated, and serve only as a support for the so-called "tail." Perhaps no one of the feathered class presents such incongruities in its make-up. Its metallic hues and markings distinguish for it a coloration unrivaled by that of any other bird. But its legs and feet are homely, and its voice one of the harshest and most repulsive known. Its proud strutting with expanded tail has made its name a synonym for vanity in all ages, even the Scriptures in their single allusion to it, associating it with the frivolous apes.

FIG. 259.

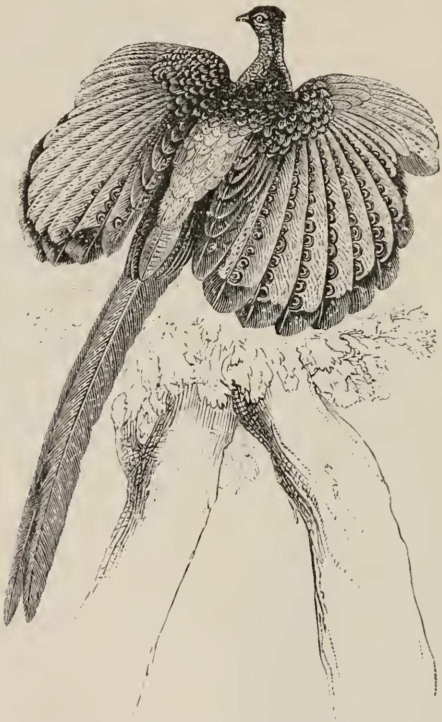


Pā'vo cris tā'tus. Peacock. ($\frac{1}{27}$.)

The *Pheasant* is indigenous to Asia, but some species have become naturalized in the parks of European castles.

The *Argus* has its secondaries, which are three times the length of the primaries, ornamented with rows of richly-tinted "eyes." Its tail has two feathers, so long that, while the bird is only the size of a common fowl, its extreme length is five feet. To this species likewise, Nature has denied beauty of song, or other form of attraction than its singularly beautiful plumage, which has suggested its generic name.

FIG. 260.

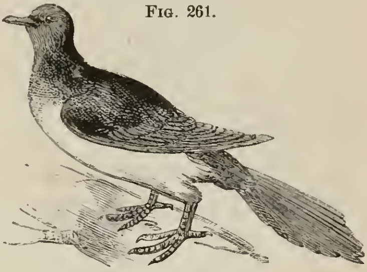


Ar' gus gi gan tē' us. Argus Pheasant. ($\frac{1}{15}$.

ORDER COLUMBÆ (kō lŭm′bē).

The **Pigeons*** have the bill shorter than the head, with the nostrils imbedded in soft skin; and the hind toe on a level with the others. Both male and female disgorge into the mouths of the young a milky substance, and when a few days old, macerated grain.

Fig. 261.



Ec to pĭs′ tes mi gra tō′ rĭ a.
Passenger Pigeon. (1/8.)

The *Wild*, or *Passenger Pigeon*, was once common to all parts of North America, where it frequently collected in such numbers as to load with nests every tree in a forest forty miles long. Each nest contains two eggs, hatching usually a male and female, which are believed to pair at maturity. The male often makes daily excursions of a hundred miles to procure food.† Many millions being thus congregated, it is astonishing how each bird, in returning, should go straight to its own mate and nest.

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* All the domestic varieties, now numbering nearly forty, are believed to have sprung from the Rock Dove (*Co lŭm′ ba lĭv′ ĭ a*) of Europe and Asia.

† Their speed is very great. Pigeons have been killed near New York with their crops full of rice, which must have been eaten in the plantations of Georgia and Carolina, six or seven hundred miles distant. As they would digest grain in twelve hours, they must have traveled a mile per minute. They fly in enormous columns, miles in length and width. It is estimated that such a flock would require millions of bushels of food each day. Audubon gives a vivid description of a resting-place on Green River, Kentucky. He says: "The noise which they made reminded me of a strong sea-breeze amongst the cordage of a ship. When they passed above my head, I felt a current of air which astonished me. Thousands were already struck down by men armed with poles, but they continued to arrive without intermission. Fires were lighted. The birds precipitated themselves in masses, and pitched where they could, one upon the other, in large heaps like barrels. Then the branches gave way under the weight, cracked and fell, bringing to the ground and crushing the closely-packed flocks, which covered every part of the trees. It was a scene of tumult and confusion. In vain I tried to speak, or even to call the persons nearest to me. It was with difficulty that I could hear the guns fire, and I only perceived the men had fired by seeing them reload their arms. Pigeons continued to come, and it was past midnight before

ORDER RAPTORES* (răp tō′rēz).

The Birds of this order have hooked beaks and powerful talons. The plumage of the sexes is usually unlike, and the offspring for two or three seasons resembles the mother-bird. The male of most species is smaller than the female, and not quite so plain in its color.

The order is thus tabulated:

RAPTORES.	EYES LATERAL...........	Head naked. ..	Claws blunt.	*Vulture.*
	EYES LATERAL	Head feathered.	Claws sharp.	*Hawk.*
	EYES DIRECTED FORWARD.	Outer toe versatile..............		*Owl.*

The American Vultures, being designed in the economy of nature to dispose of carrion, possess a strong beak for dismembering the dead bodies on which they feed. If one soaring aloft detects with its telescopic eye a carcass, the change of its flight from a circular sweep to a right line of descent is probably noticed by many others too

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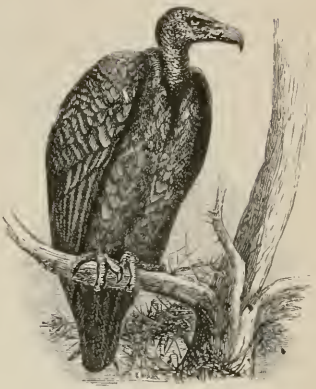
I noticed any diminution. The uproar continued all night. At last, the day approached, the noise began to abate a little, and long before we could distinguish objects, the pigeons commenced to start, and at sunrise, all that could fly had disappeared. Now it was the wolves' turn, the howls of which saluted our ears. Foxes, lynxes, cougars, bears, rats, opossums, and martens, bounding, running, climbing, pressed to the quarry, whilst eagles and falcons of different species flew down from the air to take their part of such rich booty. The sportsmen then, in their turn, entered into the midst of the dead, the dying, and the wounded. The pigeons were piled in heaps, each took what he wished, and the pigs were left to satiate themselves on the remainder."

* The birds of prey do not deserve the name of "robbers." Their carnivorous propensities are only in accordance with their physiological structure, which demands animal food. Their place in the economy of nature is therefore as fixed as that of the animals on which they prey; and to associate with them notions of cruelty and rapine is unwarrantable and irreverent. They do not, it is true, charm our ears by their songs, nor delight our eye with their colors—for either would betray their presence to their victims and frustrate the design of their creation—but they faithfully perform their mission as scavengers. They also, like the carnivora generally, serve to prevent the undue increase of the Herbivora.

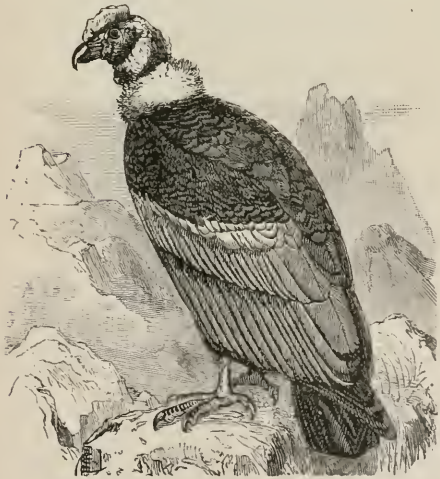
distant to be seen by the human eye, and thus a large flock quickly gathers from all quarters of the heavens.* The head and neck are bare, to enable them to be plunged deeply into a carcass. As the naked skin, however, would suffer in the cold air, the base of the neck is encircled with a ruff of soft down, arising from a loose fold, into which the neck and most of the head can be withdrawn, while the overgorged bird remains in a semi-torpid state during the digestion of its meal,—a wise provision of Nature for its comfort.

FIG. 262.



Rhyn ŏg′ rўph us au′ ra.
Turkey Buzzard. ($\frac{1}{13}$.)

FIG. 263.



Sar cor hum′ phus grўph′us. Condor. ($\frac{1}{16}$.)

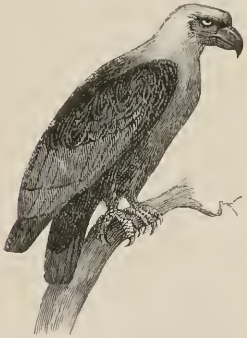
To this family belong the *California Vulture* [*Pseudogryphus californianus*] (sū dŏg′rĭ fus kal i fôr-ni ā′nus), the *Black Vulture* [*Catharista atrata*] (kath a rĭs′tȧ a trā′tȧ), the *Turkey Buzzard* [*Rhynogryphus aura*] (rhĭn-ŏg′rĭf us au′rȧ) of the

* Both sight and smell seem to aid them in the pursuit of their food. The latter sense is remarkably keen, and they have been seen to descend directly from a great height in the air to putrefying food that was concealed from their vision.

warmer regions of America, and the *Condor of the Andes.* The last is typical of the group, and is our largest bird of prey. Its alar extent averages about nine feet. It will frequently soar for half an hour without once flapping its wings; but how this is accomplished, has not been satisfactorily explained. To man, the Condor is inoffensive, nor does it often attack living prey.

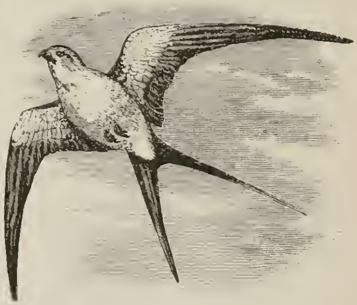
The *White-headed Eagle* is the chosen symbol of our country.* It sometimes rises in the air by a series of spiral curves, and with an almost imperceptible motion of its wings, until it is a mere speck in the sky. Thence it may descend with lightning-like velocity. Its swoop is in a cycloid, which is a line of swifter descent than a perpendicular, and also easier for alighting.

Fig. 264.



Ha li aë' tus leu co ceph' ă lus.
White-headed Eagle. ($\frac{1}{20}$.)

Fig. 265.



Nau' clĕ rus fur cā' tŭs.
Swallow-tailed Hawk. ($\frac{1}{13}$.)

The *Swallow-tailed Hawk* feeds upon reptiles and insects,† but never upon birds or quadrupeds.

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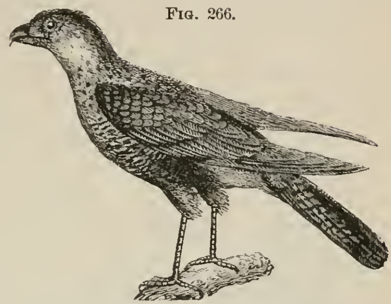
* Equally indifferent to the extremes of heat and cold, as well as to a maritime or an inland life; now honestly pursuing an independent vocation, and anon acting the part of a freebooter and robbing the Fish-hawk of its well-earned food, it is not an altogether unsuitable emblem of the nation.

† Fond of wasps, it may sometimes be seen holding a nest in one claw and picking out the grubs with its bill.

The *Caracara Eagle* of tropical America relishes dead and living animals equally, and carries off its prey with either beak or claw. Associated in the extreme Southern States with the true vultures, it completes their scavenger work.

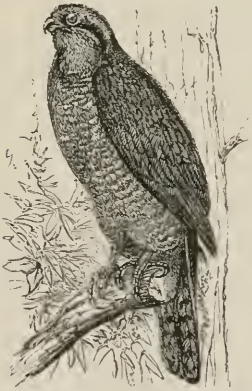
FIG. 266.



Pol y bō′rus thu rus. Caracara Eagle. ($\frac{1}{11}$.)

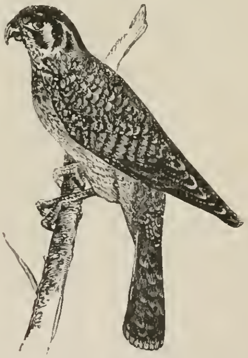
The *Goshawk* (ġŏs′hạk), or *Blue Hen Hawk*, flies low, until just over its prey, when it stretches down its powerful talons and catches it up, with hardly a deviation from a horizontal course.*

FIG 267



As′tur a tri ca pĭl′lus. Goshawk. ($\frac{1}{13}$.)

FIG 268



Făl′co spar vē′rĭ us. Sparrow Hawk. ($\frac{1}{8}$.)

The *Sparrow Hawk*, though one of the smallest, is a typical Falcon, having a notched bill. So quickly does it close its wings when alighting that they seem to dis-appear. It will often imitate the cry of a young bird, to induce the old to leave their hiding-places.*

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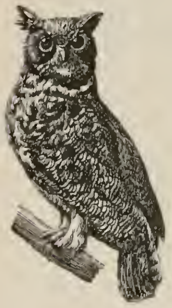
* A Goshawk was once observed to dart with the swiftness of an arrow upon a flock of blackbirds crossing a river, and giving five successively the death-squeeze, to return and pick them up one by one and bear them to the shore to be eaten at leisure.

The **Owls** comprise about two hundred species. The sexes are colored alike, and the mottled markings are nearly as apparent in the young as the old.† So soft and downy are the feathers, that in its nocturnal foraging the Owl's flight is noiseless as a shadow; while its acute sense of hearing detects the feeblest rustling as of a mouse. Living upon injurious vermin, it deserves protection from the ruthless war waged against it. The Owl is the only bird that can bring both eyes simultaneously to bear upon an object.

Fig. 269.



Bū′ bo vir gin ĭ ā′ nus.
reat-horned Owl. ($\frac{1}{13}$.

The *Great-horned*, with a single exception, is the largest Owl of the United States. It is often called the "*Cat Owl*," as its tufts, erectile at will, give its head a sinister aspect, quite feline.

ORDER PSITTACI (sĭt′tă sī).

The **Parrots** have a thick bill, the upper mandible strongly hooked at the end, with a naked space at the base; tongue fleshy and round; first and fourth toes turned backward, neither being versatile. They are perhaps the most intelligent of birds, being often taught in captivity to imitate the human voice.* Of the three hundred and fifty species, more or less, embraced in the order, fully one half belong to South America. In the Parrots, too, is found in their varied coloration, a wonderful mimicry—some species exhibiting the greatest variety of gay plumage, corresponding to the brilliant-hued flowers, among which they flit in securing the fruit on which they feed; while other species, more somber in their dress, are adapted to the forests, less gorgeous in their floral aspect.

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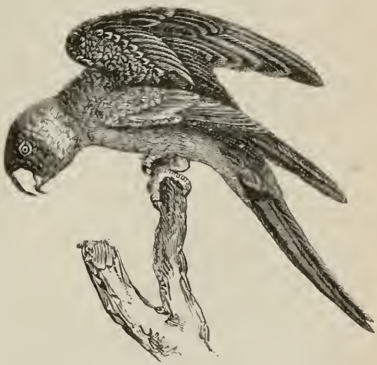
* When a Bird of Prey wishes to kill an animal with its claws, it has only to rest down with its own weight, and the bending of the legs will thrust its talons deep into the flesh of its victim (see Fig. 217).—The principle is illustrated in the roosting of a common fowl. Its grasp of the perch is involuntary, the muscles of the leg being so contrived that when the limb is bent the foot closes and remains so without any exertion of the will; and when straightened, the toes open and the hold is relaxed. A bird can not keep its foot open when its leg is bent. This may be verified by watching a fowl walking. It closes its toes as it lifts its foot, and spreads them out again as they touch the ground.

† Some species are dimorphous (double-form) in plumage. Two young of the same sex in the same nest may start with different markings, and retain them through life.

FIG. 270.



Conū'rus carolinĕn'sis. Carolina Parrot. (1/7.)

The *Carolina Parrot*, the single species found in the United States, is rapidly becoming extinct. Its prevailing *adult* color is green with yellow head and neck, and brick-red forehead. Its curiosity is its greatest foe. One of a flock being shot, the rest will keep alighting near by, till all are captured.

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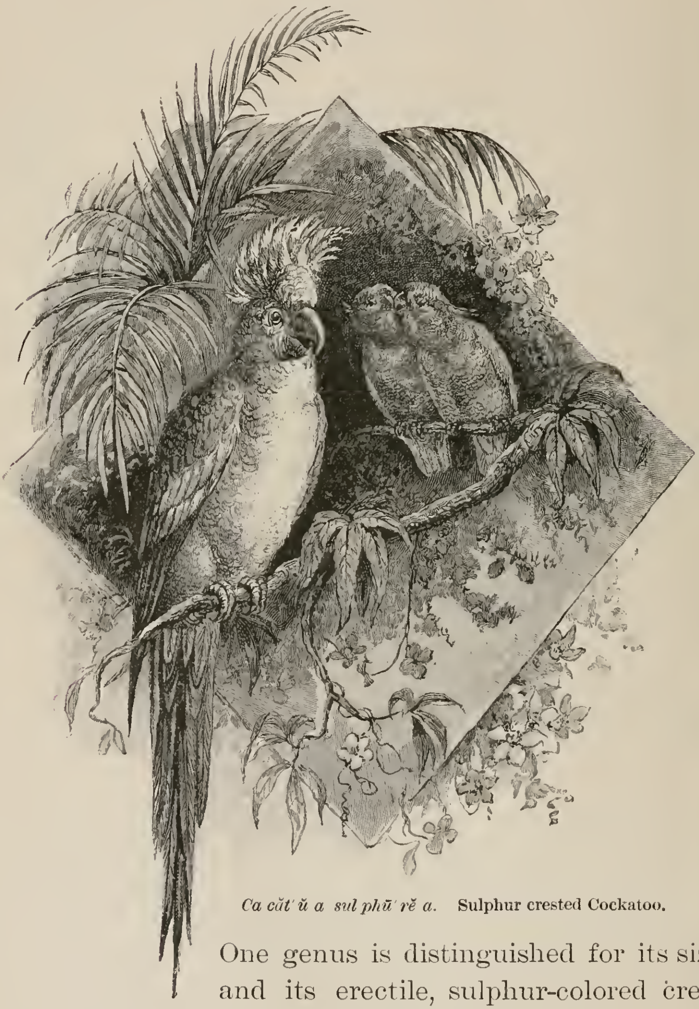
* Its language is often so pat as to show that the bird really understands its use. Goldsmith tells a story of a Parrot belonging to Henry VIII., which fell into the Thames. It immediately bawled out "A boat! a boat! twenty pounds to save me." A man thinking some one was drowning, threw himself into the river, but was astonished to discover it was only a bird. Finding the king was its master, he carried it to him and claimed the promised reward. Henry laughing at the story, paid the amount "with good grace."—Lord Dundonald, in his autobiography, says that once some ladies were being hoisted up the sides of a vessel by means of a chair suspended by a rope. Two or three had been safely deposited on deck, when, as the chair was just starting again, a parrot shouted out, "Let go!" The sailors, thinking it the boatswain's order, dropped the rope and away went the poor lady, chair and all, into the sea.

Cockatoos are forms often seen in our menageries. They differ from parrots in being feathered to the bill.

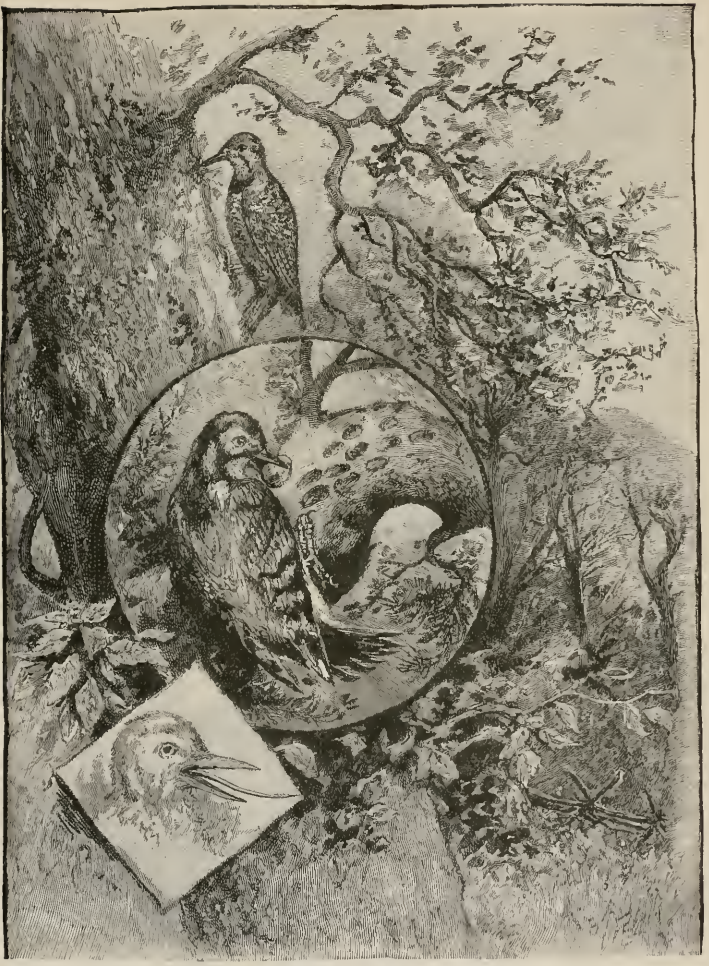
FIG. 271.



Ca căt′ ŭ a sul phū′ rĕ a. **Sulphur crested Cockatoo.**

One genus is distinguished for its size, and its erectile, sulphur-colored crest, but especially for its longevity—individuals having lived in captivity more than a hundred years.

Fig. 272.

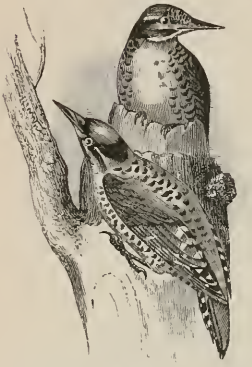


Woodpeckers.

ORDER PICARIÆ (pĭ kā′rĭ ē).

The birds of this large order are quite dissimilar in form, but possessing characteristics sufficiently similar to warrant grouping them into the same ordinal rank.

FIG. 273.



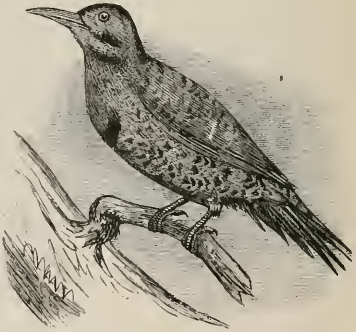
Pi coi' des hir sū' tus. Banded Three-toed Woodpecker. ($\frac{1}{6}$.)

The **Woodpeckers** are the typical *Zygodactyles* (zĭg ō-dăk'tĭlz) [yoke-toed], generally having toes in pairs, one pair before and one pair behind. Their tongue can be thrust far out, and a hole once made to the lurking-place of an insect, the tip, barbed on the upper side and viscid with saliva, quickly transfers the victim to the gullet of its captor. The tail of most of the species aids in supporting the body. The lustrous, white eggs are laid on chips at the bottom of excavations made in the trees by the parents.

The *Three-toed Woodpecker*, of which there are three species, is rarely found south of the Canadas or northern Maine.

The *Golden-winged Woodpecker* is the most extensively distributed through North America, and the most beautifully colored of its group. The male is distinguished from the female by the black patches on its cheeks, looking like side-whiskers.

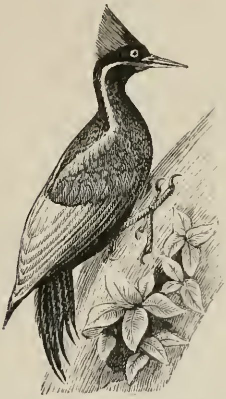
FIG. 274.



Cɵ lăp' tes au rā' tus. Golden-winged Woodpecker. ($\frac{1}{6}$.)

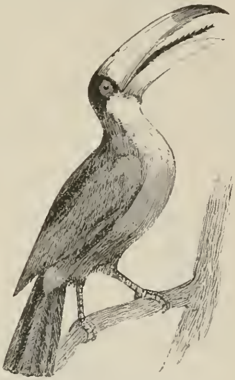
The *Ivory-billed Woodpecker* is the largest north of Central America. With its wedge-shaped bill, which is so hard as to strike fire from a flint, as does steel, it can bore a hole three feet deep for its nest in the trunk of a living tree. As a protection from the rain, it generally makes the opening under a large branch.* Its undulating flight, often by a single sweep from tree to tree, as if the bird had been swung with closed wings in a curved line, is the perfection of graceful movement.

FIG. 275.



Cam pheph' ĭ lus prin ci pī' us.
Ivory-billed Woodpecker. ($\frac{1}{10}$.)

FIG. 276.



Rham phăs' tos tu cā' nus.
Toucan, South America ($\frac{1}{8}$.)

The *Toucan* (tōō'kăn) is noted for a feathery tongue in an enormous bill of honey-comb structure, to render it light and yet strong. It feeds on soft fruits and meats; and as its large bill renders necessary throwing back the head that the fruit may fall down the throat, it has been erroneously reported as tossing up its food to catch it as it falls. At roost it usually elevates the long tail over the back, and curving its neck, so disposes of the two lengthened appendages, bill and tail, as to be almost inconspicuous. There are more than fifty species, varying greatly in plumage and size, but all have some portion of the plumage brilliant with glaring colors.

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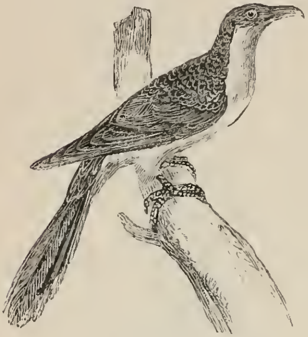
* This bird is so strong that strips of bark several inches in length are often detached with such rapidity as to fall to the ground in a shower.

The **Cuckoos** inhabit all countries. Their toes are in pairs, the exterior being somewhat versatile, in one species quite so. The only species found in England is parasitical in its incubation, like the American cow-bird. Its young hatches simultaneously with its nest companions, whom it soon tosses out upon the ground.

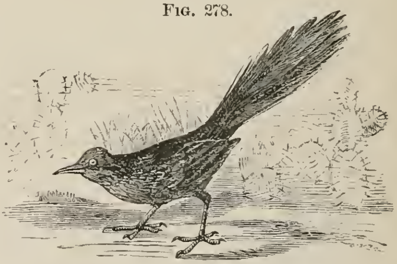
Fig. 277.



Cŏc′ cy̆ gus a mer i cā′ nus.
Yellow-billed Cuckoo. ($\frac{1}{5}$.)

The *Yellow-billed Cuckoo*, with its near relative, the *Black-billed* [*C. erythrophthalmus*], (e ri trof thăl′ mus), is found throughout North America. They are both fond of hairy caterpillars, which few birds will eat.* Unlike the European species, they build a nest, though it is rude and airy. Laying their eggs, however, at long intervals, they protract the breeding season from one to four months; the same nest often containing a new egg, one just hatching, a young bird partly fledged, and another ready to fly.

Fig. 278.



Ge o cŏc′ cyx cal ĭ for ni ā′nus. Road Runner. ($\frac{1}{12}$.)

The *Road Runner*, a ground bird† found in south-western North America, is so swift of foot that for a quarter of a mile it will outrun a fleet horse.

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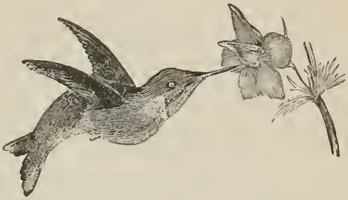
* The Cuckoo's gizzard is often found lined with caterpillars' hairs, so tenaciously adhering by their minute barbs as to require microscopic examination to prove that they do not grow from the coating of the stomach.

† It often carries the beetles and snails on which it feeds to a particular spot in order to break the shell, and thus piles of the broken fragments collect at that place.

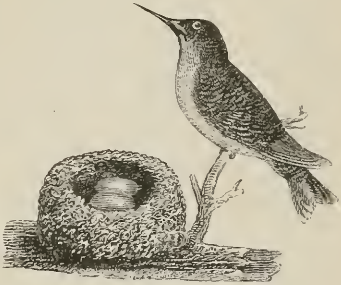
Humming-birds are peculiarly American. About 450 species are recognized, yet only one, the *Ruby-throated*, visits the North Atlantic States, and but ten any part of the United States. They are the smallest as well as the gayest of birds, blending in their rich plumage the rarest colors of flower and gem. Their bills, shaped according to the form of the blossom they are designed to penetrate for insects, vary greatly—some being short and straight, others longer than their bodies, and yet others greatly curved. The Humming-bird can fly so rapidly that the eye can scarcely follow its flight, or, by beating the air with its wings, sustain itself in front of a flower almost immovable. Many species build tiny, cup-shaped nests of vegetable down, with an outer coating of lichens glued on with saliva. Each contains two little white eggs, the size of a pea.

FIG. 279.



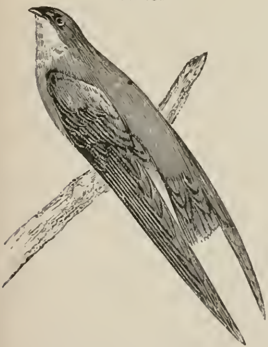
Trŏch' ĭ lus cŏl' ŭ bris.
Ruby-throated Humming-bird. (½.)

FIG. 280.



Nest of Humming-bird.

FIG. 281.



Chæ tū' ra pe lăs' gĭ a.
Chimney-swallow, or Swift. (½.)

The *Swift** alights readily on a

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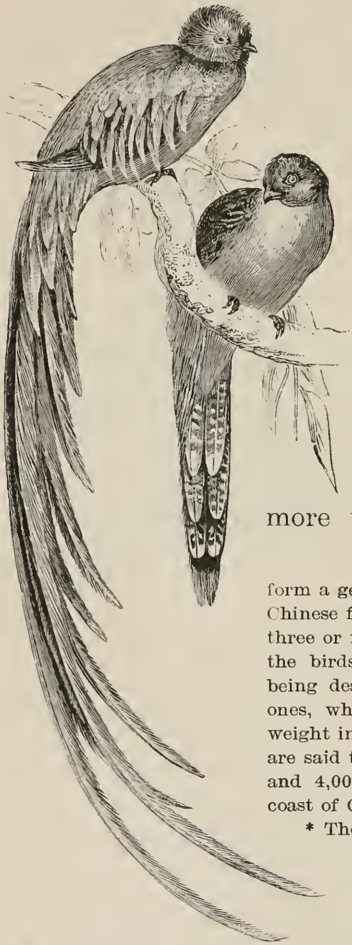
* This bird is so called from its great power of flight. One species of this group (*Col lo căl' ĭ a es cu lĕn' ta*) is the principal maker of the "Edible birds' nests." The bird constructs these out of its glutinous saliva. When washed and soaked, they

perpendicular surface, to which it clings with its sharp claws and short spined tail. The *Chimney-swallow*, the only American species, while on the wing, adroitly breaks off twigs with its feet, and fastens them to the chimney with its tough, glue-like saliva so strongly that the brick to which the nest is attached will sometimes yield before the cement.

The **Trogons** (trŏġ′ŏnz) of the tropics are pre-eminent for brilliancy of plumage* and lengthening of the tail feathers, which, in some species, exceed the other feathers by more than two feet.†

FIG. 282.



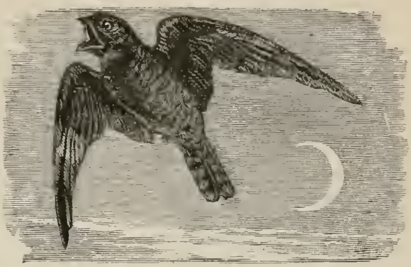
Ca lū′ rus re splĕn′ dens. Resplendent Calurus. Male and Female. ($\frac{1}{10}$.)

form a gelatinous substance, highly esteemed by the Chinese for making soup. The nests are taken down three or four times per year from the caves to which the birds are accustomed to resort, the old nests being destroyed to compel the birds to build new ones, which, when fresh and unused, bring their weight in silver. The proprietors of a cave in Java are said to receive 50,000 florins annually for rent, and 4,000,000 nests are yearly exported from the coast of Cochin China.

* The ancient Mexicans kept large aviaries of these birds, both on account of their beauty and their gorgeous plumes, which were plucked at a certain season and worked into mosaic images and pictures.

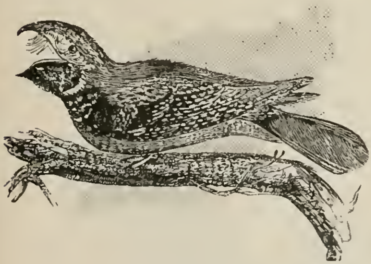
† They inhabit Mexico and Central America (Guatemala having chosen this bird for its national emblem), but only at the height of several thousand feet above the level of the sea. Its tones, not altogether unmelodious, are said to be ventriloquistic, often deceiving the hunter as to its distance from him.

Fig. 283.



Chor deī' les po pĭt' ŭ e. Night-hawk. ($\frac{1}{8}$.)

Fig. 284.



An trŏs' tŏ mus vo cĭf' ĕ rus. Whip-poor-will. ($\frac{1}{5}$.)

The *Night-hawk*,* notwithstanding its popular name, retires to rest at the close of twilight, when it can no longer discern its insect prey.† Its sharp squeak is occasionally varied by a loud, booming sound, emitted when its downward flight is arrested during a swoop near the surface of the earth.‡ Its two eggs are usually laid on a rock, or some place exposed to the sun, without any nest, though the mother broods them assiduously, fluttering away, when alarmed, as though wounded. If disturbed, it will, like the Whip-poor-will, carry off the eggs or young in its capacious mouth to another locality. The *Whip-poor-will* is silent during the day. The exceedingly sensitive bristles, lining each side of the upper mandible, are of use in directing the swiftly-flying insect

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* The Night-hawk and Whip-poor-will are commonly believed to be identical. They are really, however, distinct not only in color markings, but also generically, thus:

Gape without bristles.	Tail narrow, forked.	*Night-hawk.*
Gape with bristles.	Tail broad, rounded.	*Whip-poor-will.*

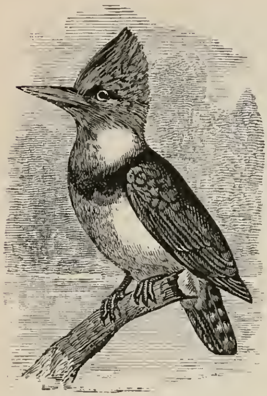
The Chuck-will's-widow of the South is larger than the Whip-poor-will, and has bristles with lateral filaments.

† Its singular habit of perching lengthwise on a limb or rail is well known; but in confinement it often perches across a finger, or the back of a chair.

‡ The former sound is produced by its vocal organs; the latter is thought to be by a quick, vibrating motion of the wings.

between its mandibles. After each sally for food, it usually returns to the same perch.

Fig 285.



Cer′y̆ le al′cy̆ on.
Belted King-fisher. ($\frac{1}{7}$.)

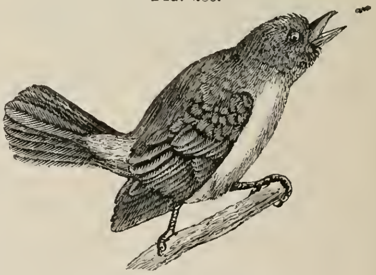
The *King-fishers** have a long, pointed beak, and the outer and middle toes united as far as the last joint. For nesting, they dig holes ten to fifteen feet deep in a sand-bank.

ORDER PASSERES (păs′sĕr ēz).

The **Passeres** always have the four toes on nearly the same level, with the hind one exactly opposite the others, giving great facility in perching.† They excel in vivacity and song, and stand highest in the order of classification.

The *Fly-catchers* are American, though comparatively few of the genera belong to North America. They are not strictly insectivorous, but in general are indispensable to the farmer.

Fig. 286.



My i ăr′ chus cri nī′ tus.
Great-crested Fly-catcher. ($\frac{1}{4}$.)

The *Great-crested Fly-catcher* is extending its habitat northward and eastward to localities where it was unknown at the beginning of the century. It makes its nest in hollow trees or stumps, generally lining it with cast-off snake-cuticles.

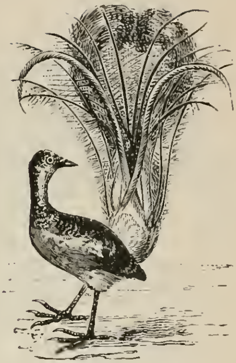
---

* They always bring the fish out of the water seized near the tail. If small, it is swallowed immediately, head foremost; if large, it is carried to a rock or stump and thrashed till dead.

† They are therefore known also as Insessores, or Perchers.—Some authors have subdivided this order into *Os′ cĭn es*, songsters, and *Clăm ă tō′ res*, screamers. Amid such diversity, any tabulation into families would be unsatisfactory.

The *Lyre-birds* of Australia are noticeable for the shape of the tail and their habit of making small round hillocks, on which the male is continually trampling while gracefully erecting and spreading its plumes.

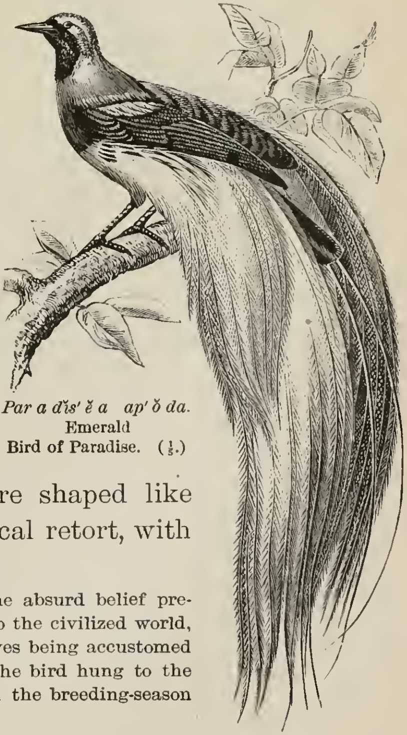
FIG. 287.



Me nū' ra su pĕr' ba.
Lyre-bird. ($\frac{1}{10}$.)

The *Paradise-birds* are natives of New Guinea and the adjacent islands. The *apoda** (footless) is the most beautiful. The brilliant plumed tufts beneath its wings and the bright emerald green of its head and neck are particularly striking.

FIG. 288.



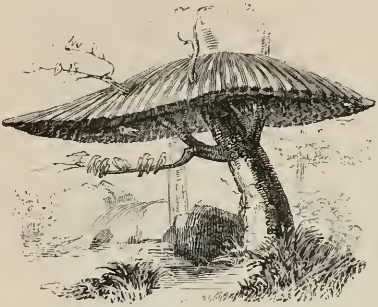
Par a dĭs' ĕ a ap' ŏ da.
Emerald
Bird of Paradise. ($\frac{1}{5}$.)

The **Weaver-birds** are found only in India and Africa, and are named from the inimitable construction of their nests. Some of these are pendent from the twigs of tall trees whose branches overhang a stream, and are shaped like an inverted bottle or chemical retort, with a long tube for the entrance, made of fibers so loosely put together that a reptile would drop off into the water. Others similarly suspended are pyramidal in shape and divided into two chambers — the outer, perhaps, for the use of the male, and the inner for the eggs of the female.

---

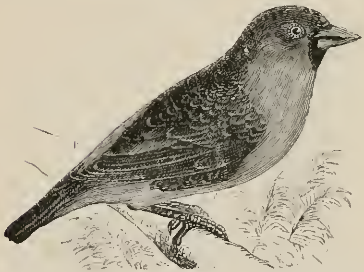
* The bird was so named from the absurd belief prevailing, when it was first introduced to the civilized world, that it had no feet, the cunning natives being accustomed to cut them off, and to assert that the bird hung to the trees by its plumes, and that it passed the breeding-season in Paradise, fed on dew.

Fig. 289.



Nest of Sociable Weaver-bird

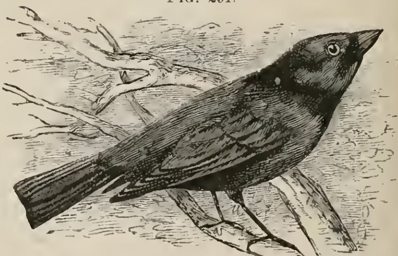
Fig. 290.



Plo cē' us sō' cĭ us. Sociable Weaver-bird. (⅓.)

The *Sociable Weaver-bird* is polygamous. A colony of two or three hundred construct in a tree a huge, sloping roof, impervious to rain. Beneath this, side by side, each female makes her nest, three or four inches in diameter, weaving it to the roof. When completed, the lower surface of the umbrella-like structure appears perforated by small openings, like the cells of a bee-hive, all the birds living together in perfect harmony.

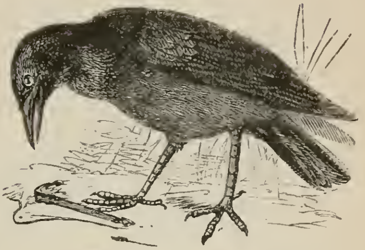
Fig. 291.



Mŏl ŏ thrus pĕc' ŏr is. Cow-bird. (⅓.)

The *Cow-bird* is gregarious and polygamous, exhibiting neither conjugal nor parental affection. The female lays in the nests of other birds, usually those of similar appetite, and whose eggs hatch two days later. The adopted nestling being larger, obtains the greater share of food, and its foster companions are generally soon stifled or starved.*

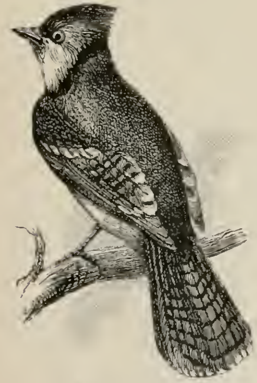
FIG. 292.



Cŏr′ vus cō′ rax. Raven. ($\frac{1}{12}$.)

Crows and species of **Jays** pass so insensibly into each other as hardly to present a dividing line. The *Raven*, though rare in the Eastern States, is generally distributed throughout North America.† It exhibits wonderful sagacity in eluding the hunter, seeming to detect at a glance the difference between a person going quietly about his business and one "on mischief bent."

FIG. 293.



Cy an ū′ ra cris tā′ ta.
Blue Jay. ($\frac{1}{6}$.)

The *Blue Jay*'s pleasing plumage is in startling contrast with the harsh notes of its ordinary song. Though irritable and quarrelsome, it has been tamed and taught to pronounce certain words. It is of great service in planting the seeds of forest-trees and in devouring, during the winter season, the eggs of the destructive tent-caterpillar.

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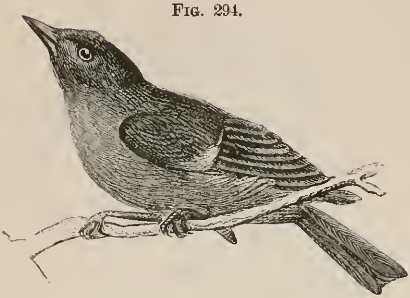
* Their dead bodies are probably removed by their parents, as they are never found near the nest, which would be the case, if, like the Cuckoo of Europe, they were thrown out by the young Cow-bird.

† The Raven is generally considered as of evil omen. It is easily tamed and taught to repeat sentences. Charles Dickens, in his preface to "Barnaby Rudge," gives his amusing experience with tame Ravens. Our common *Crow* (*Cŏr′ vus a mer i cā′ nus*) can be distinguished from the Raven by being much smaller and by having its throat-feathers oval and close; while those of the Raven are sharp and scattered. The *Rook* (*C. fru gil′ ĕ gus*), so familiar to every European traveler, and which congregates in flocks about churches and old ruins, does not eat carrion.

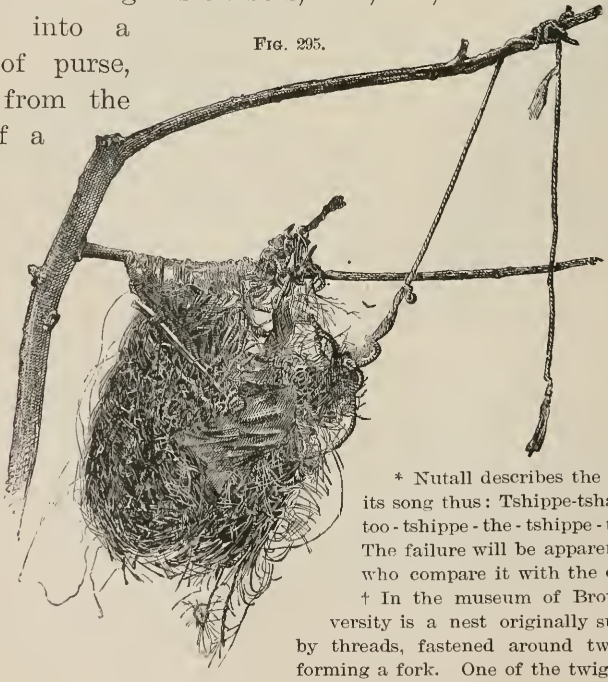
Fig. 294.



Ic'tĕ rus bal'tĭ mōre. Baltimore Oriole. (¼.)

The *Baltimore Oriole*, noticeable for its brilliant plumage, almost invariably reaches the latitude of Southern New England on the 10th of May. Its rich and full-toned melody defies verbal equivalents.* Though pernicious by injuring the pea-crop, it more than compensates by destroying the canker-worm and the tent-caterpillar, which few birds venture to disturb. The Oriole's nest is composed of vegetable fibers, hair, etc., woven into a kind of purse, hung from the end of a limb.†

Fig. 295.



Nest of Oriole.

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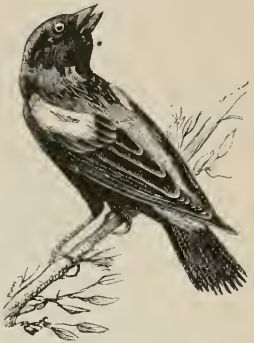
* Nutall describes the notes of its song thus: Tshippe-tshayia-too-too-tshippe-the-tshippe-too-too. The failure will be apparent to all who compare it with the original.

† In the museum of Brown University is a nest originally sustained by threads, fastened around two twigs forming a fork. One of the twigs breaking off three days before the young were

The *Bobolink* is one of the most beneficial or destructive of birds, according to the season of the year and the locality. In its spring migrations, it is the pest of the Southern wheat-fields; and in its autumnal flight, of the rice plantations. It renders, however, a redeeming service in devouring cotton-worm larvæ, and in its breeding-places it is purely insectivorous. The female conceals her nest on the ground amidst the standing grass, alighting or rising a distance from it.*

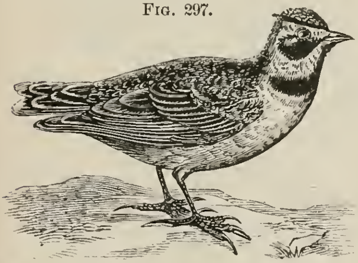
FIG. 296.



Dol i chŏn′yx or y̆ ziv′ŏ rous. Bobolink, or Rice-bird. (⅓.)

The **Larks** are distinguished by long and nearly straight hind claws. The *Shore-lark* is the only representative indigenous to North America; but the most noted is the European *Sky-lark*, which has been introduced into certain localities of the United States. It rises with quivering wings almost perpendicularly, singing the while, until it passes out of sight, though not out of hearing; and then drops headlong down into the meadow again, in a very ecstasy of song.

FIG. 297.



Er e mŏph′ ĭ la cor nū′ ta. Shore-lark. (⅓.)

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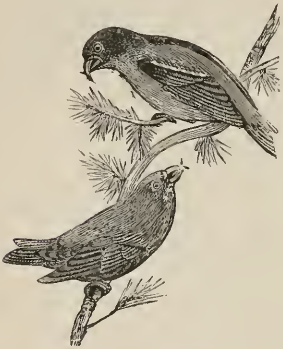
ready to fly, the old bird procured a piece of twine at least two feet in length, and, after winding several inches of one end many times around the part of the branch still imbedded in the matting of the nest, drew all taut and then fastened the other end by a tuck-under knot to a fork in the branch full ten inches above. Fig. 295 is engraved from a photograph of this curiously-mended nest.

* The grotesque, though charming song of the Bobolink is a curious medley of jingling, incomprehensible notes, uttered with an earnestness that borders upon the ludicrous, especially when thirty or forty begin, one after another, and at length get into an exact concert; but, when the listener is just beginning to be enraptured, the music suddenly ceases.

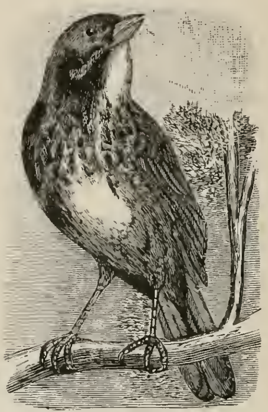
The *Cross-bill*, when matured, has its mandibles lapping, though the young do not possess this peculiarity. While this anomalous form does not unfit the bird for eating insects and soft fruit, it peculiarly adapts it to obtain food from the seed of pine and fir cones.*

FIG. 298.



Cur vi rŏs′ tra leu cŏp′ tĕ ra.
Cur vi rŏs′ tra a mer ĭ cā′ na.
Cross-bill. ($\frac{1}{6}$.)

FIG. 299.



Me lŏs′ pĭ za me lō′ dĭ a. Song-sparrow. ($\frac{1}{3}$.)

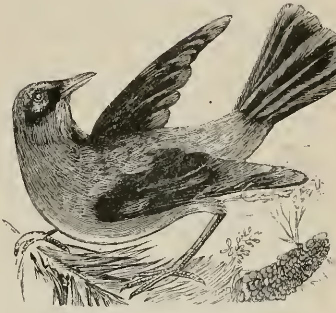
The **Finches**† are distinguished by a short, conical bill, usually notched. The *Song-sparrows* are our earliest and latest musicians. Those nesting in the far north pass the latitude of New England late in November, and return in early March; always in full song, with notes "louder, clearer, and more vibratory than those that come to us and remain to breed."* It nests both on the ground and in trees, only the older birds selecting the latter, as though taught by experience the greater security.

---

* These seeds are concealed beneath hard scales. To secure them, the bird, clinging to the slender twig with one foot, grasps the cone with the other; then inserting its bill between the scales, by drawing the lower mandible sideways, pries them apart, when the tongue, which is furnished with a peculiar horny scoop, darts into the opening, dislodges the seed and carries it to the mouth.

† The necessity of examining not only a great number of specimens of the same bird, but also those from different localities, is especially apparent in this group. Each region of North America seems to possess a different variety. So completely, however, do the forms of a series of hundreds of specimens from different places, insensibly grade into one another, that eight species have been united in one by recent authors,—a fact commending itself persuasively to the attention of young students of Nature.

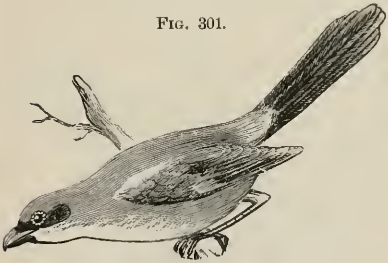
FIG. 300.



Py răn′ ga rū′ bra. Scarlet Tanager. (⅓.)

The male *Scarlet Tanager* (tăn′ă jer), in the third and following years, has, with the exception of the jet-black wings and tail, a fiery-red plumage, in brilliant contrast with the green leaves among which it flits. After the August molting, and during the first year, it is not distinguishable, in its greenish livery, from the female, its gay summer plumage being assumed on re-entering our southern borders in the spring. The birds of this group feed mainly upon insects, and claim protection as among the most useful of our songsters.

FIG. 301.



Col lŭ rĭ o bo re ā′ lis.
Shrike, or Butcher-bird. (¼.)

The *Shrike* devours the larger insects and smaller birds, striking them senseless by one blow upon the head with its powerful toothed beak. Its claws being feeble, it impales its victims upon thorns, often a number at a time on the same bush, that it may eat them at its leisure. While dismembering, it cunningly stands upon the inner side, so as to transfix them more completely.†

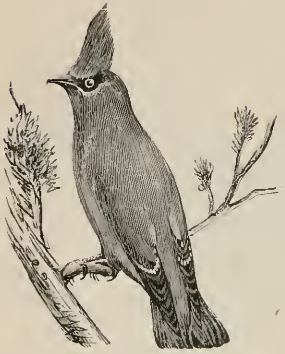
---

* Individuals have been known to sing "nine entirely different sets of notes," usually uttering them one after another in the same order.

† In like manner it has been observed, when in confinement, to weave the

The *Cedar-bird* is noticeable for the exquisitely fine and silky texture of its plumage; its erectile crest; and the remarkable appendages to the shafts of the secondaries (and sometimes to the tail), of a bright vermilion, resembling red sealing-wax. It appears in New England about the last of May, in flocks of fifteen or twenty, ridding the orchards of the destructive span-worm, or canker-worm; and then pairing off and nesting late in June or early in July. In return for its invaluable services, it helps itself somewhat freely to the smaller fruits, and hence is most unwisely persecuted.*

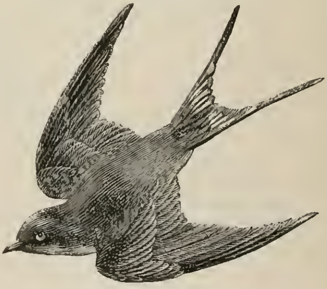
Fig. 302.



Am pē' lis ce drō' rum.
Cedar-bird. ($\frac{1}{5}$.)

The *Swallows* have long wings, which enable them to be almost constantly in flight.† The *Barn Swallow* is the most common species, and is de-

Fig. 303.



Hi rŭn' do hor re ō' rum.
Barn Swallow. ($\frac{1}{8}$.)

---

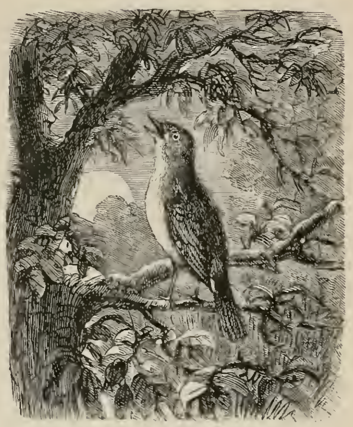
body of a mouse between the wires of the cage, that it might bear a heavier pull while being torn in pieces.

* Often alighting side by side, the outer one of the series will pluck a cherry within reach and pass it to the second, and he to the third, and so on to the end, and then back again to where it started, repeating the maneuver several times, until, the appetite whetted up, some one of the line will take a bite and spoil the fun.

† The Swallow flies at a rate of more than a mile a minute, which, if sustained during ten hours a day for ten years, the supposed life of the bird, would give over two million miles, or upward of eighty-seven times the circumference of the globe.—The wide-spread belief that the flying high of Swallows indicates settled fair weather, and the flying low foul weather, may have foundation in the barometric changes of the atmosphere, varying the height of the strata of air in which they forage for insects.

servedly a favorite, as there is no evil blended with its many benefits. Purely insectivorous, it destroys alike the pests of fruit-trees, of cattle, and of man.

FIG. 304.

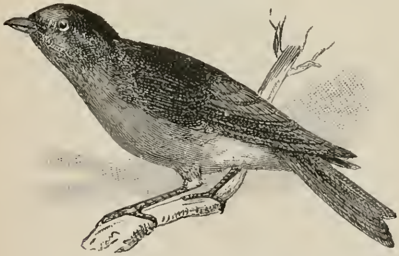


Phĭ lŏ mē′ la lus cĭn′ ĭ a. Nightingale. (⅙.)

The *Two-colored Swallow* [*Hirundo bicolor*] (hī rŭn′do bī kŏl′or) builds in our bird-houses.

The *Nightingale* of Europe has been famed from time immemorial for the sweetness of its voice. It is a shy bird, but its song is occasionally heard during the day, though it is most pleasing in the silence and serenity of a moonlight evening. Both sexes sing, though the male excels. Its plumage is a modest reddish-brown above and a whitish-gray beneath—a mimicry adapting it to the foliage among which it loves to hide itself.

FIG. 305.



Si a′ lĭ a si ā′ lis. Blue-bird. (⅕.)

The *Blue-bird* represents in America, the *Robin-redbreast** [*Erythacus rubecula*] (e rĭth′ă kus ru bĕk′ŭ la) of Europe. Were the blue of the former replaced by the brown-olive of the latter, the two birds could hardly be distinguished.†

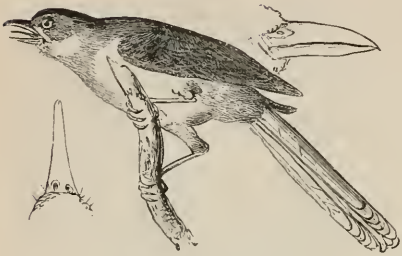
---

* The European Robin-redbreast must not be confounded with the American Robin.

† Their social nature corresponds as fully as their physical, and the Blue-bird would figure as appropriately in the beautiful legend of "The Babes in the Wood" as the traditional Robin-redbreast.

The **Thrushes** are found in all parts of the world. The bird organization reaches in them its highest development.

FIG. 306.

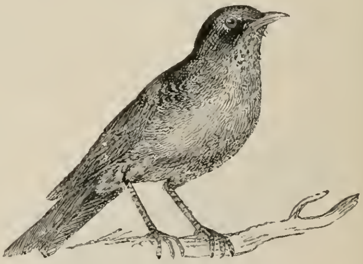


Mī' mus -pol y glŏt' tus. Mocking-bird. (¼.)

The *Mocking-bird** is remarkable for its varied melody and wonderful power of imitation.†

The *Robin* alone of its family seems to court the society of man, following close upon the plow and spade, and often nesting in a corner of the piazza. It is a ground bird, seldom picking worms from a tree, and never catching them as they dangle in the air, but snapping them up the moment they touch the sod. One of the earliest-comers and latest-goers of the migratory birds, no one labors more zealously in the service of all, or, in comparison with the good it does, takes a smaller amount of toll.‡

FIG. 307.



Tŭr' dus mi gra tō' rĭ us. Robin. (⅕.)

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* Southern Pennsylvania is the usual northernmost limit of the Mocking bird, although it has been known to breed for successive years in Massachusetts.

† There are few songs or sounds which it does not mimic so perfectly as to deceive the most experienced ear. As it pours forth its medley of harmonious music and discordant noise, birds answer to what they think is the call of their mates, or the scream of the hawk; the dog hastens to what he imagines the whistle of his master; the hen hurries at the fancied cry of her frightened brood, and the child runs to the window, attracted by the supposed sound of a creaking wheelbarrow.

‡ However voraciously he may for a single month feed upon strawberries and cherries, the rest of the season he serves both the horticulturist and the agriculturist. In nothing is he injurious to the latter; while to both he is in-

CLASS MAMMALIA (mam mā′lĭ ȧ).

General Characteristics.—To the class of MAMMALS belong man and those animals which resemble him in the most important parts of their organization. The distinguishing features of this class are, that they suckle their young, and that their bodies have, in general, a full or partial covering of hair. Some being designed for a life purely terrestrial, others mainly aërial, and others aquatic, they exhibit, as compared with the birds, great variety of structure, as will appear in the following tabulation for Orders:*

	ORDERS.	EXAMPLES.
OVIPAROUS FORMS, BIRD-LIKE	*Mon ō trĕm′ ă tȧ*	Duckbill.
YOUNG CARRIED IN POUCH	*Mär sū pĭ ā′lĭ ȧ*	Opossum, etc.
TOOTHLESS FORMS	*E den tā′tȧ*	Sloth, etc.
FORMS WITH GNAWING TEETH	*Ro dĕn′ tĭ ȧ*	Rat, etc.
SMALL BURROWING FORMS	*In sĕc tĭv′ ŏ rȧ*	Mole, etc.
FLYING FORMS	*Chei rŏp′ tĕ rȧ*	Bat.
WHALE-LIKE, CARNIVOROUS	*Ce tā′ cĕ ȧ*	Whale, etc.
WHALE-LIKE, HERBIVOROUS	*Sī rē′ nĭ ȧ*	Manatee, etc.
FORMS WITH PROBOSCIS	*Pro bos cĭd′ ĕ ȧ.*	Elephant.
FEET PARTLY HOOFED, GNAWING FORMS	*Hy ra coĭd′ ĕ ȧ.*	Coney.
FOUR FEET HOOFED, GRAZING FORMS	*Un gū lā′ tȧ.*	Horse, etc.
TEETH COMPLETE, FLESH EATERS	*Car nĭv′ ŏ rȧ*	Cat, etc.
FORMS WITH PREHENSILE FEET, NON-ERECT	*Quad ru mā′ nȧ*	Monkey.
ERECT, TWO-HANDED	*Bī mā′ nȧ*	Man.

---

valuable for destroying the larvæ of almost every insect found upon or (within the length of its bill) beneath the surface of the soil. Wherever the Robins and birds of similar habits are destroyed, these insects and worms increase to an alarming extent. A wise Creator has designed the birds not only for ornament and pleasure, but to serve a definite purpose in protecting vegetation. Prudence would teach us to protect them as our faithful servants.

* **Dental Formula.**—As the teeth present important characteristics for classifying the Mammals, zoologists designate the number by a formula, which, as applied to man, reads thus:

$$i\ \frac{2-2}{2-2},\ c\ \frac{1-1}{1-1},\ pm\ \frac{2-2}{2-2},\ m\ \frac{3-3}{3-3} = 32.$$

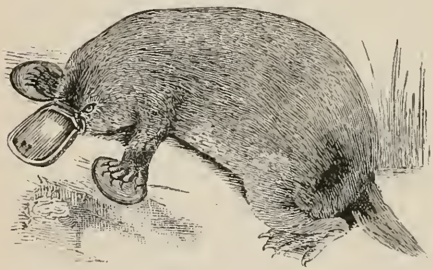
This signifies that there are eight incisors, two on each side of each jaw; four canine teeth back of the incisors; eight premolars (bicuspids) back of the canine; and twelve molars back of the premolars.

ORDER MONOTREMATA (mŏn ō trĕm′ă tȧ).

The **Monotremes** (mŏn′ō trēmz), found only in Australia and vicinity, form a connecting link between the Birds and the Mammals.

The *Duck-bill** introduces us to the Mammals. The bill of a duck is attached to the body of an otter; while the male bears on the inner side of the ankle a spur resembling that of the domestic fowl. The fore feet have a web extending beyond their extremities, which can be folded up when the feet are used for burrowing, or expanded when employed in swimming. The hind feet are webbed only to the base of the nails. The body is covered with fur, beneath which is a layer of wadding-like hair, impervious to water. Its burrow runs under ground forty or fifty feet, with one entrance under water, and another just above. At the farther end is a nest of grass, for the rearing of its young, which are hatched and cared for as in the following genus. It swims upon the surface, diving frequently, like the duck, and using its bill for securing its food of small insects and crustaceans; these are stored in its capacious cheek-pouches, till it comes to the surface to masticate them at its leisure. So far as present discoveries indicate, it stands lowest in the series of mammals.

FIG. 308.



Or nĭ tho rhy̆n′ chus an a tĭ′ nus. Duck-bill. (⅛.)

The *Porcupine Ant-eater* has a bird-like head, though the jaws lack the horny covering of the Duck-bill. It has no teeth, and feeds on insects, which it captures with its long flexible tongue. Its body is covered with hair and spines. When surprised, it rolls itself into a ball, or burrows flatwise into the earth with surprising rapidity. Recent investigation asserts that this animal deposits an egg which is placed in a fold of the skin—a pouch—until it finally hatches; the young is retained in the pouch, by the mother, until it is able to care for itself.

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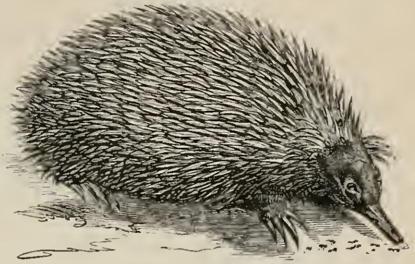
* See "Fourteen Weeks in Geology," p. 173.

Fig. 309.

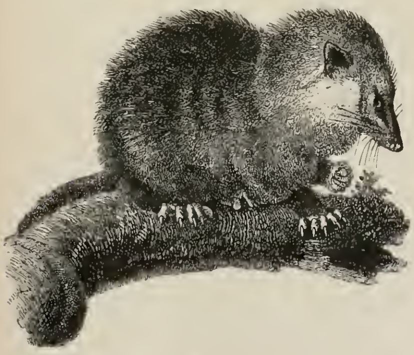


E chĭd′ na hȳs′ trix. Porcupine Ant-eater. ($\frac{1}{9}$.)

ORDER MARSUPIALIA (mär sū pĭ ā′ lĭ ȧ).

The **Marsupials** (pouched) are not over an inch long at birth, when they are immediately transferred to a pocket formed by the skin of the mother's abdomen. Nourished by milk, they remain there, as in a living cradle, till able to take care of themselves. The dentition shows that some are carnivorous, while others are herbivorous. Except two genera, they belong to Australia and adjacent islands.

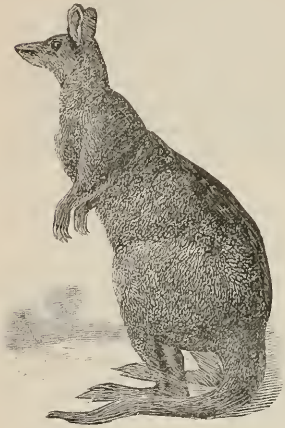
Fig. 310.



Dī dĕl′ phys vir gin i ā′ na. Opossum.

The *Opossum* belongs to this Continent, but of the thirty species, only one is found in North America. The common variety is about the size of a cat, with a pointed head; large, naked ears; sharp teeth; rough tongue; long, prehensile tail; and curved claws.* It is mostly nocturnal and arboreal, and both herbivorous and carnivorous.

FIG. 311.



Măc′rŏ pus mā′jor.
Kangaroo. ($\frac{1}{36}$.)

The *Kangaroos* are noted for their small fore and large hind limbs. The latter with the powerful tail form a tripod to sustain the animal when sitting; but when feeding, it goes upon all fours. The young often protrude their heads from the abdominal pouch and crop the herbage at the same time with the mother. When alarmed, the Kangaroo bounds off twenty feet at a leap.† Its eyes are large and have a peculiar gazelle-like expression, in strange cōntrast to that of its glistening white teeth. The different species vary in height from that of a rabbit to that of a man; the *Macropus* being the largest. Australia and the adjacent islands are the home of the Kangaroo.

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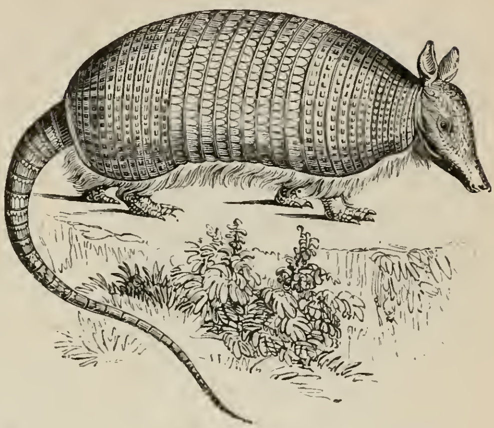
* Hunting the animal is a favorite sport in some of the Southern States. In the bright moonlight evenings of the autumn, parties go out for this purpose with dogs. The Opossum hides in the thick branches of a tree; but, when shaken down, rolls into a ball and feigns itself dead; after a few moments it slowly opens one eye, then the other, and if unhindered sneaks away. The young weigh only about four grains when put in the pouch by the lips of the mother, and are blind and deaf. Within a week their tails become prehensile enough to twine around one another's bodies. In five weeks they are able to crawl out and are sometimes found on the back of the mother, with their tails grasping hers, which, in turn, may be twisted about a branch.

† It is eagerly hunted for its flesh and skin. Though an exceedingly timid animal, dying often in captivity of sheer fright, yet, when brought to bay by the hounds, it seizes them with its fore limbs and endeavors either to drown them, in the water, or to lay them open with its hind claw.

ORDER EDENTATA (ē den tā′tȧ).

The **Edentates** have the teeth, when present, poorly developed, the claws remarkably strong, and the body protected by unusual dermal outgrowths.

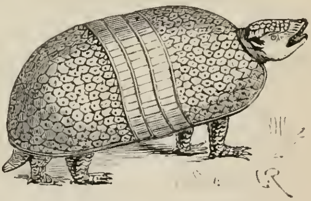
Fig. 312.



Dā′ sy̆ pus no vem cĭnc′ tus. Nine-banded Armadillo. ($\frac{1}{7}$.)

The *Armadillos* (är ma dĭl′lōz) were so called by the Spaniards from their "coat of mail." This bony armor consists of agglutinated hairs; freedom of motion being secured by a series of transverse bands.

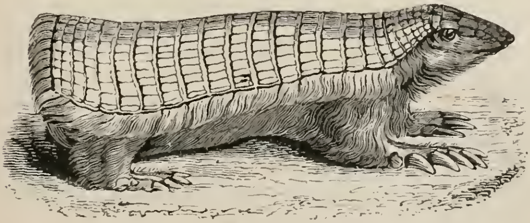
Fig. 313.



Tol y peu′ tis tri cĭnc′ tus.
Three-banded Armadillo. ($\frac{1}{10}$.)

The so-called *Nine-banded Armadillo*, which may have from six to ten bands, abounds in Central America, and is domesticated to clear the houses of vermin. The *Mataco* (măt′ a kō), or *Three-banded Armadillo*, does not burrow, but for defense rolls itself into a ball. The *Pichiciago* (pish ĭ cha′ go)

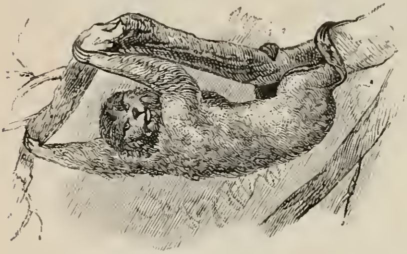
Fig. 314.



Çhlā my̆ph′ ŏ rus trun cā′ tus. Pichiciago. ($\frac{1}{2}$.)

resembles the mole in its habits. Its short tail, bent under the body, serves to make a tripod with the fore feet, "while the hind feet are set to work simultaneously, discharging the sand with incredible swiftness.

FIG. 315.



Brăd′ y̆ pus trī dăc′ ty̆ lus.
Ai, or Three-toed Sloth. ($\frac{1}{10}$.)

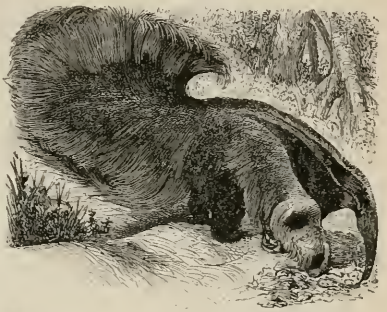
The **Sloths*** are naturally divided into the two-toed and three-toed. They are peculiar in having the number of cervical vertebræ different from the normal,—one of the two-toed having six, while the three-toed have nine. All other mammals, with the single exception of the *Sirenia* (sī rē′ nĭ ȧ), invariably have seven. The hair is of a peculiar texture, counterfeiting the masses of moss which drape the tropical forests, and is given a green hue by the presence of a small plant which grows attached to it. They are found only in the tropical regions of the New World. The *Ai*, so called from its cry, lives on the under side of the branches of trees, even sleeping suspended back downward. Its elongated arms are of use in reaching for boughs, the succulent leaves of which it draws to itself for food.

The *Giant Ant-eater* of South America has toothless jaws a foot long. It can open its mouth, however, only far enough to thrust forth its long, worm-like tongue. With its fore feet, armed with powerful nails, it tears open an ant-hill, when the bewildered inmates rush out, and, sticking to its tongue, viscid with saliva, are rapidly swept into its mouth. When sleeping, it wraps itself in its large, bushy tail, and thus mimics a heap of dried grass, to escape the notice of its enemies. Attacked, it rises upon its hind feet, and clasps its enemy, its strong claws being a match for the Jaguar (jăg ū är′). It is, however, quite inoffensive, and rarely uses its great strength except in defense.

---

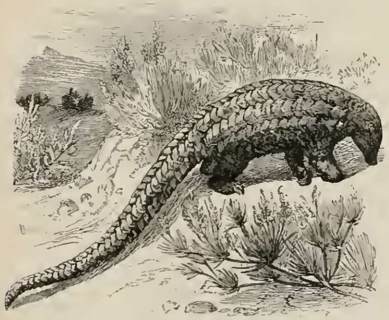
* Cuvier said of this family, "Nature seems to have amused herself in producing something imperfect and grotesque." Their fore legs are so much larger than their hind ones, that when they try to walk on the ground, they have to drag themselves along on their knees, and they seem awkward enough; but when moving on the forest-trees they are seen to be well adapted to their intended life. In avoiding pursuit, they swing from limb to limb with great rapidity, particularly in a gale of wind, when the branches are swaying toward one another. Their flesh is good eating, and they are obliged to remain constantly in the tree-tops to escape their numerous enemies.

Fig. 316.



Myr me cŏph′ ă ga ju bā′ tȧ. Giant Ant-eater.

Fig. 317.



Mā′ nis lon gi cau′ dȧ. Long-tailed Pangolin.

The *Long-tailed Pangolin* (păn′gō lin), found in Asia and Africa, is remarkable for its covering of large, horny scales, resembling the tiles of a roof, which effectually shields it from the attacks of ants.* It walks on its knuckles, with its toes turned inward.

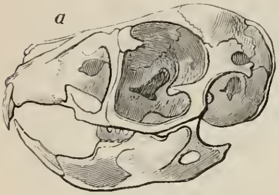
---

* W. T. Hornaday says of a species he found in Ceylon, and kept for some days as a pet, that, if alarmed, "he immediately tucked his head down between his fore legs, brought his tail under his body and up over his head, and held it there, forming of himself a flattened ball, completely covered with scales. Unable of myself to uncoil him, I called to my aid two of my assistants, but the tail stuck to the body as if it had been riveted there, and after wrestling with it till

ORDER RODENTIA (rō dĕn′shĭ ȧ).

The **Rodents** (gnawers) lack canine teeth, but have two upper and lower incisors, fitted to gnaw bark, roots, woody stems, nuts, etc. These are long, slightly curved, and deeply rooted in the jaw. The molars are generally ridged transversely, and the lower jaw moves backward and forward in mastication. Most of the order have clavicles, and hence rotary motion of the arms, allowing the food to be held to the mouth while gnawing. The edges of the teeth are of necessity always sharp, since the anterior portions are protected by an intensely hard and resisting enamel, while the softer substance of the back is constantly being worn away.*

FIG. 318.



Skull of a Rodent.

RODENTIA.	Clavicles rudimentary.	MOLAR TEETH WITHOUT ROOTS.	Tail short, furry.	*Hare.*
			Tailless...........	*Guinea Pig.*
	Clavicles well developed.	MOLAR TEETH WITH ROOTS.	Tail short, bristly.	*Porcupine.*
			Tail long, thinly haired.	*Jumping Mouse.*
			Tail medium, partially naked.	*Gopher.*
			Tail varying in length, scaly.	*Mouse.*
			Tail flattened, scaly.	*Beaver.*
			Tail long, bushy.	*Squirrel.*

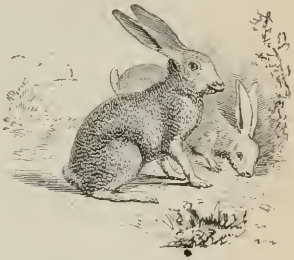
---

fairly exhausted, we gave up, beaten. Such was the wonderful power in the tail of that small animal."—*Two Years in the Jungle.*—CHARLES SCRIBNER'S SONS, 1886.

* If one of the incisors be broken off, its opposite continues to grow, sometimes curving, in which case at length it locks the jaw, and the wretched animal starves to death.

The *Hares* are distinguished by two small teeth behind the chisel-like upper incisors. Flight being their chief means of protection, their ears are peculiarly adapted to catch the faintest rustle, and their eyes to glance easily in every direction. When alarmed, they stamp with their feet, as if to give notice of danger; and, with seeming consciousness of their mimicry, often merely squat behind a clod, and, suffering their pursuers to run over them, quickly start off in a contrary course. They generally lie concealed during the day, and venture forth only at night, seeking their food of grass, roots, and tender buds. There are several geographical varieties in the United States.

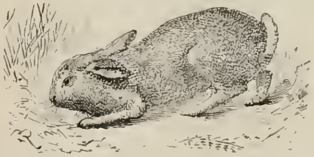
FIG. 319.



Lē pus a mer i cā nus.
Northern Hare. ($\frac{1}{15}$.)

The *Northern Hare* has in summer a tint of reddish-brown and in winter an impure white. It never burrows, but makes a "form" of grass, etc., in which it crouches, and trusts to its mimicry for concealment. It is a timid creature, loving the recesses of the thickest woods. It runs with great speed, and has been known to clear over twenty feet at a single bound. It is very fierce, however, and when overtaken will scratch and bite severely. The *Gray Rabbit* does not change its fur in the winter to so decided a white as the Northern Hare, or White Rabbit, as it is often called. Though making burrows

FIG 320.



Lē'pus syl văt ĭ cus. Gray Rabbit.* ($\frac{1}{10}$.)

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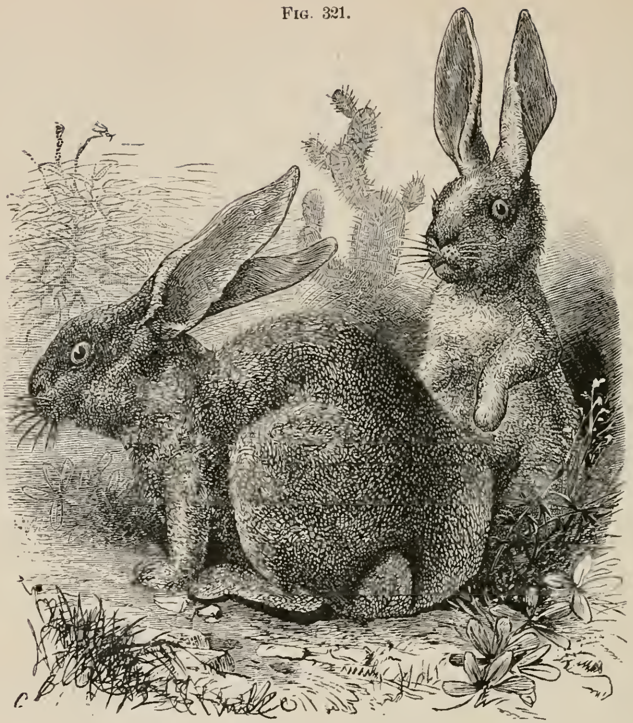
* This animal, the smallest of the hares, is misnamed in this country, as there is no rabbit indigenous to America.

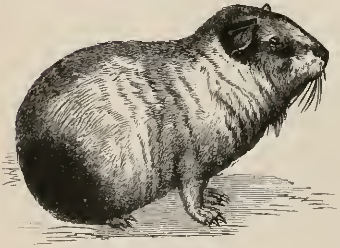
FIG. 321.



Lē′ pus cam pĕs′ tris. Jack Rabbit. ($\frac{1}{10}$.)

itself, when pursued, it will also take refuge in those of other animals. The Jack Rabbit of Mexico and the Western States, is remarkable for its big ears.

FIG. 322.

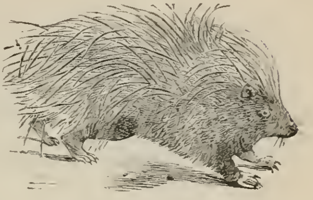


Cā′ vĭ a co bai′ a. Guinea Pig. ($\frac{1}{4}$.)

The *Guinea Pig*, originally from South America, is domesticated in all parts of the world. Though exceedingly quarrelsome with its fellows, it is gentle toward other animals.

The *Porcupine* of Europe and Africa has its back, sides, and short tail covered with spines varying from three to fifteen or more inches in length. All the American species have much shorter spines; in most not over five inches for the longest, and usually intermingled with abundant hair, longer, and thus concealing the spines. The spines are barbed with numerous reversed hooks or prickles, which are easily detached, and, once imbedded in the flesh, work deeper and deeper.*

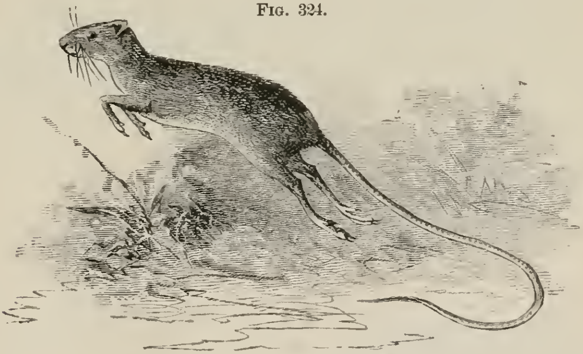
FIG. 323.



Hys trix cris ta ta.
Porcupine, Europe. ($\frac{1}{16}$.)

Jumping Mice are remarkable for their long tails and cheek-pouches. They leap away from their enemies in a zigzag course. There is but a single species in North America.

FIG. 324.



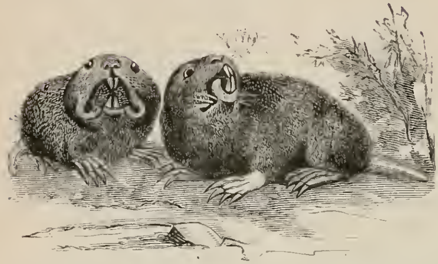
Ză′pus hud son′ĭ us. Jumping Mouse. ($\frac{2}{3}$.)

---

* None of the species can throw their quills, though all can erect them by means of powerful subcutaneous muscles. When attacked, the Porcupine, like the Hedgehog, rolls itself partially into a ball, and brandishing its tail, stands ready for the onslaught. The assailant, with nose, lips, jaws, and tongue filled with the treacherous barbs, soon retreats with a howl of pain.

The *Pouched Gopher* is so called from its curious hair-lined cheek-pouches. These open externally, and are used, not for carrying out sand from its burrow, but for carrying food.

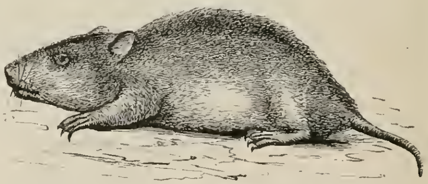
FIG. 325.



Gē′ ŏ mys bur sā′ rĭ us. Pouched Gopher. ($\frac{1}{5}$.)

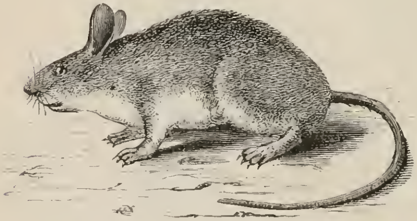
The common *Rats* and *Mice* have naked tails; five toes on the hind feet; and four on the front, with a sort of wart representing a thumb. The *Meadow Mouse* is known from the winding shallow paths it traces in the grass around its nest. The *Deer Mouse* dwells in the woods, in trees, and sometimes in houses. Besides being arboreal, it is peculiar in being partially carnivorous. Because of their singing powers, specimens are often domesticated. Its adult coloration is locally varied, but is always some shade of buff above, and snowy-white beneath, while the young are ashy-gray. These local varieties in color have mainly led to the naming of several varieties as different species, with needless confusion in their classification.

FIG. 326.



Ar vĭc′ ŏ la ri pā′ rĭ a. Meadow Mouse. ($\frac{3}{4}$.)

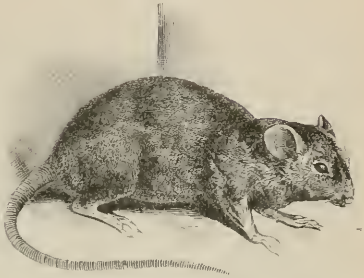
FIG. 327.



Hes pĕr′ ŏ mys leu′ cŏ pus.
Deer, or White-footed Mouse. ($\frac{1}{2}$.)

The *Common*, or *House Mouse* and the *House Rat*, both originally from Central Asia, are now found, through transportation by ships, in every part of the world.*

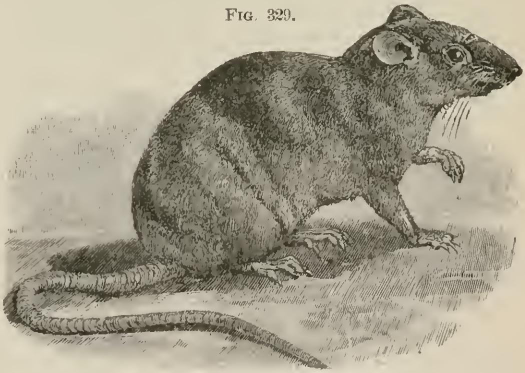
FIG. 328.



Mus mŭs' cŭ lus. **House Mouse.**

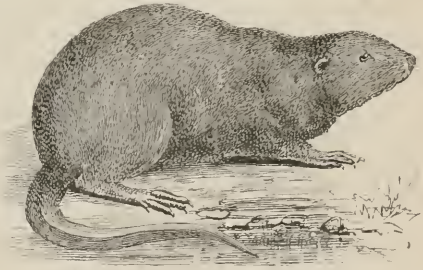
The *Musk Rat* lives on the river bank and in shallow ponds, using its vertically flattened tail for sculling. Besides long burrows in the river banks, it often constructs winter houses out of rushes and mud, but always near, and sometimes surrounded by water. That they construct these dwellings in the fall, as to their height above the water—often three feet or

FIG. 329.



Mus dec u mā' nus. House Rat.

FIG. 330.



Fī ber zi bĕth' ĭ cus. Musk Rat. ($\frac{1}{5}$)

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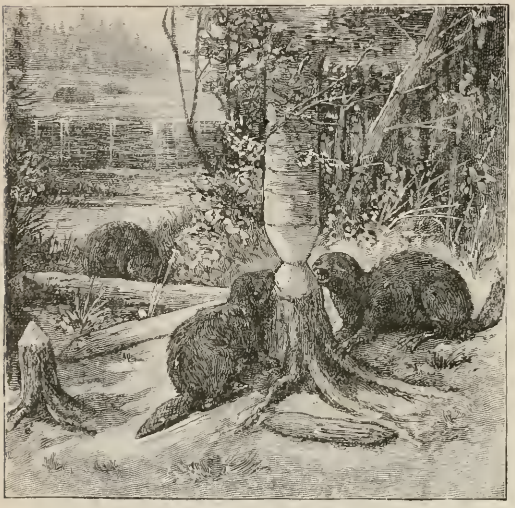
* They are exceedingly cleanly, and, in limited numbers, useful for their scavenger work and destruction of insect vermin. When food fails they migrate in companies to new places. In such journeys they often travel long distances and cross broad rivers. They take with them the old and infirm, and Dr. Franklin asserts that he once saw a rat leading a blind comrade by a twig grasped in its mouth.

more—through some foreknowledge on their part of the amount of rain-fall during the coming winter, is not sustained by careful observation.

FIG. 331.



Căs' tor can a dĕn' sis. American Beaver. ($\frac{1}{12}$.)

The *Beaver* was once abundant in North America, but it retires before civilization, and is fast becoming extinct in this country as it is becoming in Europe. Its broad tail and webbed hind feet enable it to swim with great ease. The enamel of its incisors is very hard.* It is noted for its ingenuity in building its habitations.†

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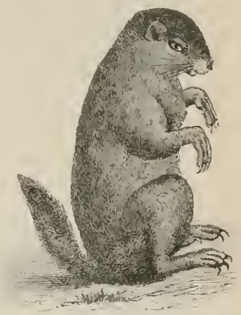
* "The Indians, before the introduction of iron among them, were accustomed to use these as chisels for working wood and horn. A tame Beaver will take an apple in its forepaws, and, by dexterously turning and pressing it against its incisors, pare it as readily as if the work had been done with a knife."—*Wood.*

† If the place chosen is by stagnant water, the Beaver at once commences building on the bank, with lower entrances from the water; but if it is a running stream, a large company combine to build a dam, in order to keep the water at the same level. Going up stream they gnaw off trees one to twenty or more inches in diameter. These they float down to the spot selected, and, laying them crosswise, fill in the interstices with mud and stone which they carry between their forepaws and chin. When the water is high enough to prevent freezing to the bottom in winter, they separate into small families, and build their houses against the dam or the adjoining bank. The entrance is beneath the water, and the vaulted roof is well plastered with a thick coat of earth, to protect against the wolverine. When they dive they always slap with their tail, and also when upon the tops of their houses inspecting them, or about their work. This has given rise to the absurd idea of their using it for a trowel to

Many of the *Squirrels* have feet formed for an arboreal life. Such have a bushy tail, which aids them in leaping, the hairs spreading out and breaking their fall. In the coldest weather they remain in their nests in a semi-torpid state, but with the first mild day are gamboling among the trees or skipping along the fences. Besides the ordinary vegetable diet, they devour large numbers of the eggs and young of birds.

FIG. 332.



Cўn' ŏ mys lu do vic i ā' nus.
Prairie Dog. ($\frac{1}{8}$.)

The *Prairie Dog* is found on the prairies west of the Mississippi. It has a short, puppy-like yelp, accompanied with a quick jerk of the tail. It digs a burrow descending at an angle of forty degrees, and having a bed of dried grass at the end. These burrows are often placed close together, forming a dog-town extending for miles. The animal has a curious habit of standing erect on the little mound at the mouth of its hole, watching intently, and at the first alarm tumbling down into its burrow. That the Prairie Dog tolerates in its habitation the presence of the Burrowing Owl and the Rattlesnake, is a myth. They are frequently found among their burrows, but only to feed upon their young.

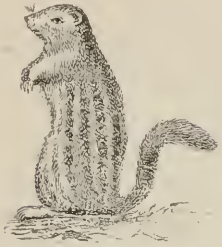
The *Striped Prairie Squirrel* is beautifully marked by thirteen stripes on a ground of reddish-brown. The closely cropped ears are a special feature of this genus,

---

plaster their buildings, and as a hod to carry the mortar they are said to prepare. Lewis H. Morgan says: "He uses his tail to pack and compress mud and earth while constructing a lodge or dam, which he effects by heavy and repeated down strokes,—an office not unlike some of the uses of a trowel." They lay up food for winter by sinking logs and bark near their houses, but in summer feed upon grass, fruits, and roots.

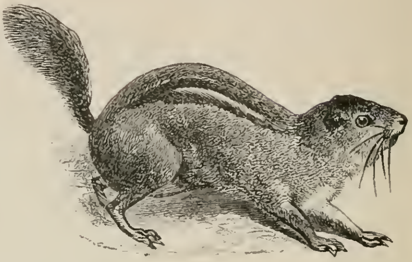
distinguishing it from the preceding. It is a beautiful western species, hibernating in the higher latitudes.

FIG. 333.



Sper moph' ĭ lus tri' dĕ cem lin e ā' tus.
Thirteen-lined Squirrel.* ($\frac{1}{7}$.)

FIG. 334.

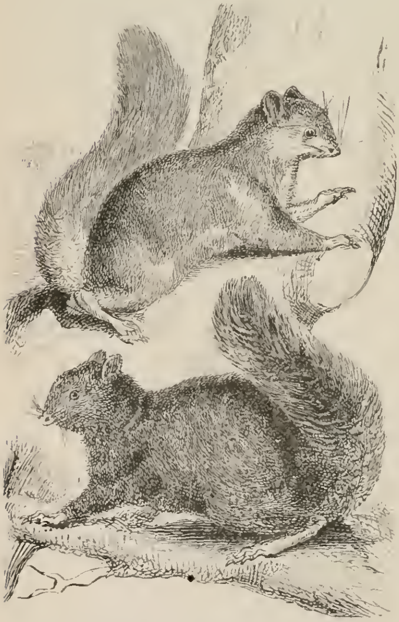


Tā' mĭ as stri ā' tus. Chipmunk. ($\frac{1}{3}$.)

The *Chipmunk*, or *Striped Squirrel*, has cheek-pouches opening internally outside the teeth, capable of carrying away four or five acorns at a time.

The *Gray Squirrel* is the most abundant in New England and the Middle States, the black variety prevailing in Western New York.†

FIG. 335.



Sci ū' rus car o lin ĕn' sis.
Gray Squirrel. Black variety of Gray. ($\frac{1}{7}$.)

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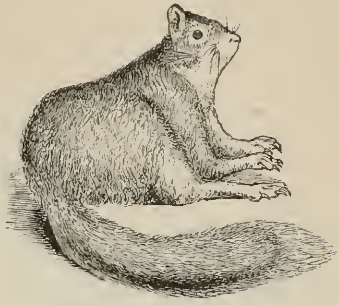
* In Iowa, Minnesota, Wisconsin, and Northern Illinois this squirrel is popuarly known as the *Gopher*. The true animal of this name is given on p. 190. The former is sometimes destructive to crops in new districts, but a few pails of water will drive it out of its shallow burrow; while it fully recompenses all its damage by destroying mice and noxious insects.

† Congregating in great numbers, they venture into unknown regions in an undeviating course,

The *Southern Fox Squirrel* has the ears and nose white, the *Western* dark or black, while the body of either may be gray, black, mottled, russet, or orange.

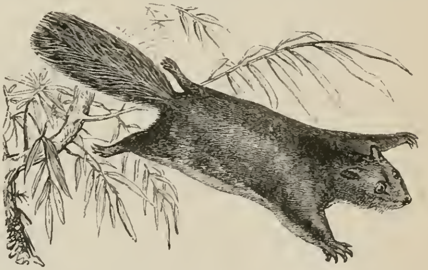
The *Flying-squirrel* has an extension of the skin of the flank between the fore and the hind legs which, with the flattened tail, forms a parachute to sustain it in leaping from tree to tree.* There is probably but one species in North America, though ranging from British America to Guatemala, but differing somewhat in color and size.

FIG. 336.



Sci ū′ rus vul pī′ nus.
Southern Fox Squirrel. ($\frac{1}{8}$.)

FIG. 337.



Sci u rop′ tĕ rus vol u cĕl′ la. Flying-squirrel. ($\frac{1}{2}$.)

ORDER INSECTIVORA (ĭn sĕk tĭv′ŏ rȧ).

The members of this order are insect-eating, and have teeth studded with points for crushing the hard integuments of their prey. They are plantigrade, with a tendency to an underground life. Those inhabiting cold countries hibernate, as their food fails them during the winter.

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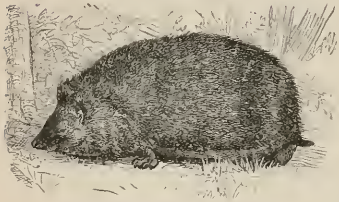
swimming broad rivers (not sailing over on a piece of bark, as fabulously related), sweeping through fields and forests, till, the imperious but inscrutable instinct satisfied, they scatter and find homes.

* It is not *flight*, since the squirrel can not propel itself in the air, nor even sustain itself at the same height. The first impulse being given by its powerful hind legs, it descends obliquely, and, just before reaching the point aimed at, by an upward movement of the tail and the impetus of its velocity, ascends a short distance, and thus alights flat upon its four feet.

INSECTIVOROUS.	BODY ABOVE BESET WITH SPINES.	Terrestrial.	*Hedgehog.*
	BODY WITHOUT SPINES.	Terrestrial.	*Shrew.*
		Subterranean.	*Mole.*
		Arboreal.	*Colugo.*

The *Hedgehog* is not found in America. Mingled with its hair are prickly spines (quills) firmly attached to the skin, and so disposed that when the animal rolls itself into a ball they project in every direction — a mode of defense which baffles the dog and the fox.

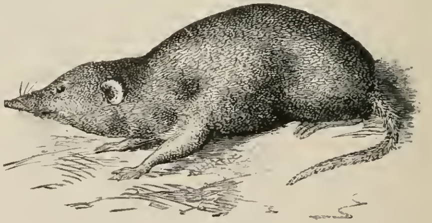
FIG. 338.



E rin ā' cĕ us Eu rō' pĕ us.
Hedgehog. ($\frac{1}{24}$.)

The *Shrew's* foot is not formed for digging, indicating its habit of living above ground. It has a long, movable snout and bristly tail.*

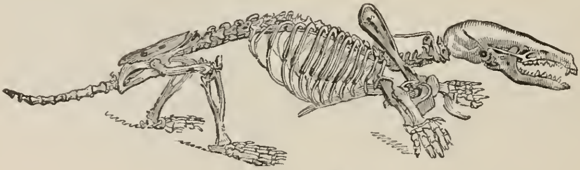
FIG. 339.



Sō' rex thomp' sŏn i. Thompson's Shrew. ($\frac{1}{2}$.)

The **Moles** are adapted to a subterranean life by having small eyes hidden in the fur, though capable of being brought forward for use; acute hearing and smell; velvet-like fur,

FIG. 340.



Skeleton of a Mole.

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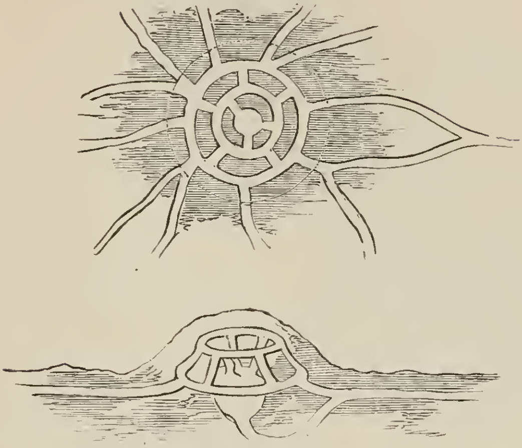
* Cats and dogs often kill them, mistaking them for mice; but on account of their disagreeable odor refuse to eat them. They are exceedingly pugnacious,

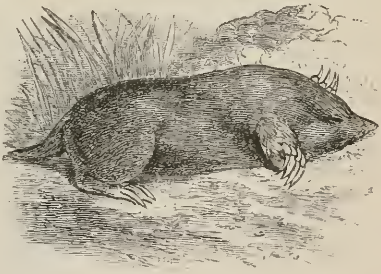
Fig. 341.



Habitation of a Mole.

with the hairs inserted vertically, so as to lie smoothly in any direction; shovel-shaped paws, with sharp, stout nails turned outward, for throwing the earth backward; and cylindrical bodies, allowing rapid movement through their tunnels. The *Common Mole*, notwithstanding its scientific name, is terrestrial. In its pursuit of worms and insects, it often burrows a gallery a hundred feet long in a single night. Generally carnivorous, it is exceedingly useful, and should be protected by every cultivator of the soil against unreasonable prejudice.

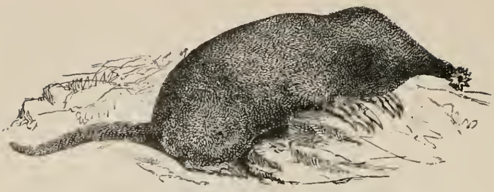
Fig. 342.



Scā' lops a quat' ĭ cus. Common Mole. (¼.)

and their fierce combats would be fearful were they not ludicrous from the diminutive size of the creature.

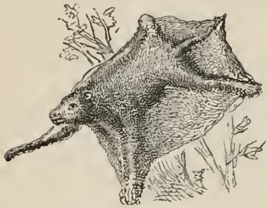
FIG. 343.



Con dy lū′ ra cris tā′ ta. Star-nosed Mole. ($\frac{1}{4}$.)

The tunnels and mounds of the *Star-nosed Mole* are often seen in moist meadow lands. The rays on the nose are of use as tactile organs.*

FIG. 344.

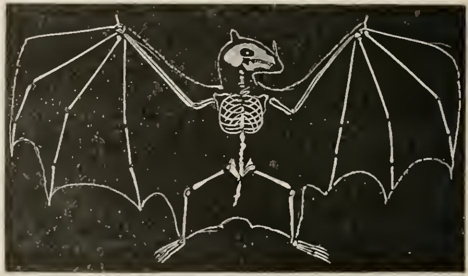


Ga le o pi thē′ cus vō′ lans.
Colugo. ($\frac{1}{20}$.)

The *Colugo* (ko lū′go) has a membrane clothed with hair, serving as a parachute to support it in a descending leap from tree to tree, sometimes for 100 yards. It is nocturnal and sleeps suspended by the hind legs.

The **Bats** are true flying mammals, the body being adapted to an aërial life. The great change is a prolongation of the arms and fingers, to sustain a thin membrane used as a wing. The thumb is left free and armed with a strong claw, enabling the bat to climb walls and run upon a rough surface. It suspends itself, however, when at rest with its hind feet. Its molars bristle with points

FIG. 345.



Skeleton of a Bat.

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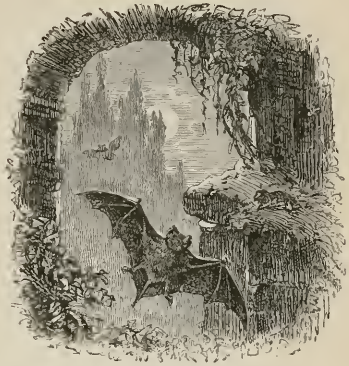
* This species is frequently found in mid-winter with its tail swollen with fat, probably to be absorbed as food during its partial hibernation.

for crushing its insect food. Its flight is that of a bird, though fluttering and lacking ease of movement. During the day it hides in caves, lofts, etc., and commonly ventures out only with the twilight. Its eye is small and apparently of little service, as it flits among bushes and intricate passages when blinded.* Associated with ideas of gloom, it inspires universal dread, yet some species render great service by devouring noxious insects. To capture these it curves forward that part of the membrane expanded between the hind legs and tail, to serve as a net. Its flight is uncertain and awkward, as ever and anon it dives downward, apparently making complete somersaults in its effort to take the "catch" from the net. The common North American Bats are of small size, feed on insects, and have the hind legs joined by a transverse membrane which includes the tail. The following table will distinguish the more common genera:

Fig. 346.



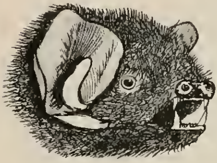
Geoffrey's Bat.

Ears enormous.	Incisors $\frac{2-2}{3-3}$.	*Plecatus.*
Ears of moderate size.	Incisors $\frac{1-1}{3-3}$.	*Atalapha.*
Ears of moderate size.	Incisors $\frac{2-2}{3-3}$.	*Vespertilio.*

* This has led some Zoologists to think that it has a sixth sense. It is probably due, however, to its extraordinary delicacy of touch.—The cry of a bat is so shrill that many persons' ears can not detect it, and Homer (Odyssey, 24, 6) compares it to the cries of ghosts.—The bat is frequently infested with the common bed-bug (*cī′ mĕx lec tu lā′ rĭ us*), and this fact may answer the question of the despairing housewife, "Where can the bugs come from?"

The Big-eared Bat [*P. macrotis*] (ma krō′tis) measures a foot in alar extent and is of a blackish color. It is found in the more Central and Southern States. The *Red Bat* [*Atalapha noveboracensis*] (a tăl′ă phă no ve bo ra cĕn′sis) is one of the most common as well as one of the most beautiful of the bats. Its bright red coat shaded with white will always distinguish it. The *Hoary Bat* [*Atalapha cinerea*] (a tăl′ă phȧ ci nē′rĕ ȧ) is our largest form, measuring fourteen inches in extent, and is quite rare.

Fig. 347.



Big-eared Bat.

Of the genus *Vespertilio* (vĕs pĕr tĭl′ĭ ō) we have several representatives. The *Little Brown Bat* is the smallest, measuring only nine inches in alar extent. It has six molars above and six below. The *Silver Black Bat* has long black hairs tipped with white. It has five molars above and six below. The *Dusky Bat*, of about the same size, has only four molars above and five below.

Of the exotic Bats, the *Indian Fruit Bat*, exhibited by traveling shows, is a most familiar form. They are of a large size, the body equaling that of a Guinea pig; but are without the sanguinivorous propensities often attributed to them. In India they make nocturnal raids on the cocoa-nut plantations and mango gardens, destroying large quantities of the fruit. On the approach of daylight, they retire to the forests, congregate, and suspend themselves by a single leg to the outspreading branches.

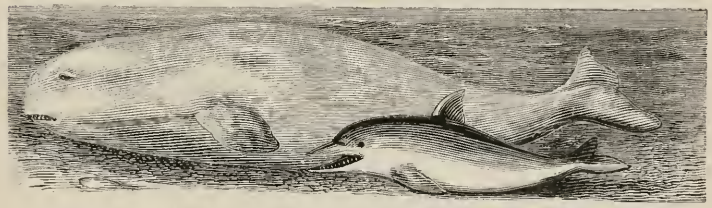
The *Vampire* of South America has, instead of a stomach, a long pouch for the reception of its food, which requires little digestion. Its teeth make a triple puncture, through which it sucks the blood of its victim till gorged. The bite, however, is rarely serious.*

ORDER CETACEA (sē tā′shĭ ȧ).

The **Cetaceans** are swimming carnivorous mammals, and destitute of hair. They have blow-holes on the top of the head, sometimes called nostrils, though it is probable that the sense of smell is but poorly developed, and in some forms it is entirely wanting. The fore limbs consist of a shoulder-blade, humerus, radius, ulna, wrist-bones, and five fingers. There is no external evidence of hind limbs. The tail is horizontally flattened and fluked. They progress mainly by vertical movements of the horizontal tail, in marked contrast with the lateral movements of the vertical tail of fishes. They may be classified according to the disposition of the teeth:

Teeth in both jaws,	*Dolphin.*
Teeth in lower jaw,	*Sperm-whale.*
Teeth wanting,	*Right-whale.*

Fig. 348.



Be lū′ ga can a dĕn′ sis. White Whale. ($\frac{1}{122}$.) *Del phī′ nus dĕl′ phis.* ($\frac{1}{36}$.)

The *Beluga* (be lū′gȧ), of the Arctic Seas, is remarkable when mature for the clear white hue of its skin, though when young it is black.

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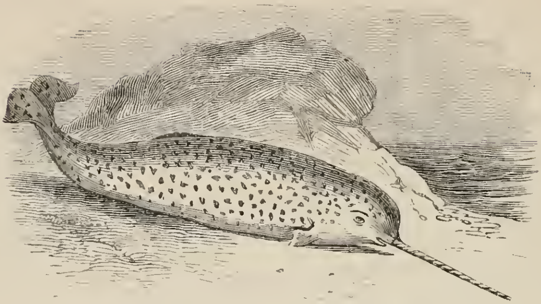
* Most exaggerated stories have been reported by travelers, as that the Vampire, winging its silent flight in the darkness, poises itself over the exposed toe of an incautious sleeper, and painlessly extracts his life-blood, all the while by gentle fanning inducing a deeper slumber, until its victim expires.

Fig. 349.

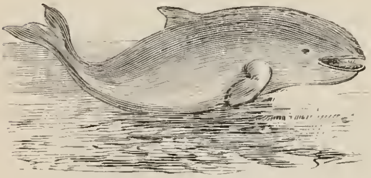


Mŏn′ ŏ don mon ŏc′ ĕ ros. Narwhal. ($\frac{1}{180}$.)

The *Narwhal* (när′whal), or unicorn, has one of its upper canines developed into a straight, spirally-twisted pole of ivory, seven to ten feet long.*

The *Common Porpoise* frequents the mouths of rivers, often venturing some distance up stream in pursuit of herring and other migratory fish.†

Fig. 350.



Pho cœ′ na com mū n is.
Common Porpoise. ($\frac{1}{32}$.)

The *Delphinus delphis* is the dolphin‡ of Grecian mythology.

The *Sperm-whale* is found in deep water in all tropical regions. It is distinguished by forty or fifty conical teeth in the lower jaw, which fit into cavities in the upper; and by a singularly abrupt snout with blow-holes in front. An immense cavity in the head is filled with cells containing an oil which hardens into spermaceti. Ambergris (ăm′bĕr grēs) is found in the intestines in masses of thirty or forty pounds. The food of the Sperm-whale consists chiefly of cephalopod mollusks. To procure these it is said to descend into the water with its immense lower jaw hanging down almost perpendicularly. When a sufficient number are collected in the mouth, the jaw closes and the morsels are swallowed.

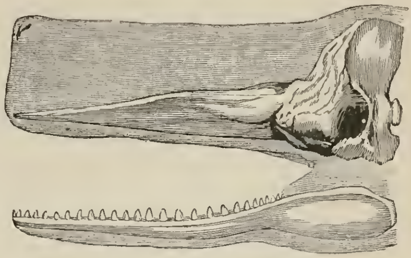
---

* This formidable weapon has been forced through the sides of a whale-ship. It can be used only as a means of defense or of plowing up the mud for food, as the animal feeds mainly upon soft shell-fish.

† It frequently comes to the surface of the water to breathe, where it tumbles and frisks about, presenting an appearance which, with its puffing, has given it the name of the Puffing Pig.

‡ This is common to all seas, but should not be confounded with the Dolphin of sailors, which in dying displays all the colors of the rainbow—the latter being the coryphene (*kor′ ĭ fē′ nē*), a true scaly fish.

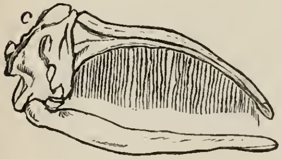
FIG. 351.



Skull of a Sperm-whale.
Phȳ sē′ ter mā crō cĕph′ ă lus.

The *Greenland Whale* being the one most sought by whalemen, is also known as the *Right-whale*. Its huge mouth is cleft to the depth of ten feet, with a breadth of six or eight.* The upper jaw, instead of teeth, has slabs of whalebone (baleen) hanging freely, about an inch apart. There are often as many as three hundred of these on each side, and the longest sometimes measures ten feet; the outer edges being smooth and solid, the inner fringed with fibers. In feeding, the whale moves rapidly forward near the surface of the water, not with open mouth, but with its lower lip dropped down, leaving the baleen exposed.

FIG. 352.



Baleen.

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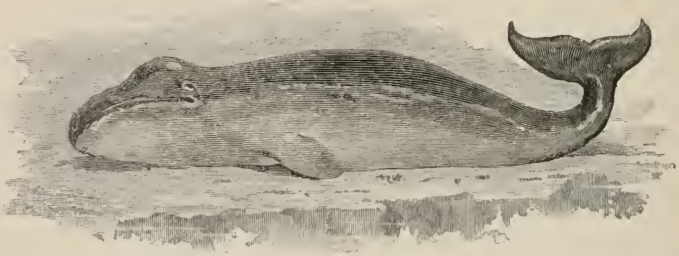
* Curiously, the throat opening out of this enormous cavity will hardly admit the entrance of the two fingers. As the whale has no teeth, it can therefore eat only very small animals.

The water rushes in, carrying myriads of minute animals. The great tongue being then raised and the lower lip lifted, the water is strained out through the baleen, and discharged at the sides of the mouth in torrents,* while the food remains, to be swallowed at leisure.

The whale has a reserve system of blood-vessels, enabling it to remain under water for an hour or more. Being an air-breathing animal, it must come quickly to the surface; hence its tail † is flattened horizontally instead of vertically, that a rapid stroke may throw up the head. Its skin consists of interlaced fibers, among which the fat is diffused to the depth, in some instances, of two feet,‡ forming the "blubber." A wise Creator adapted this thick, non-conducting, India-rubber-like

Fig. 353.



Ba læ' na mys ti cē' tus. Right Whale. ($\frac{1}{280}$.)

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* Close observers maintain that the whale in breathing never spouts water from the nostrils as the ordinary pictures represent. When it rises to the surface, a foot or more of water over the head is blown away by the breath escaping from the lungs. This is followed by the vast body of air expelled, surcharged with moisture hot from the lungs, which, cooling, changes to vapor, and in its circling descent resembles a shower of spray.

† The tail has often an area of one hundred square feet, is exceedingly flexible, and so strong that the whale can spring clear out of the water "like little fish leaping into the air after flies," falling again to the sea with a crash that is heard for miles.

‡ In other animals, as the hog, the fat lies between the skin and the muscles.

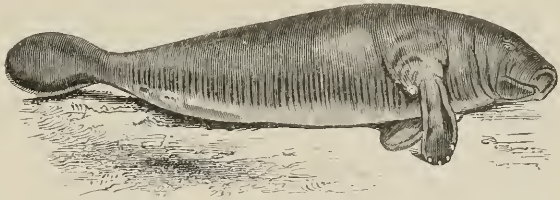
coating to withstand the tremendous pressure of water* and to protect the body from the freezing cold.†

To keep the water out of the lungs when diving, the blow-holes are provided with valves that, like a cork in a bottle, close more firmly the greater the pressure outside.

ORDER SIRENIA (sī rē′nĭ ȧ).

The **Manatee** (măn ă tē′), or **Sea-cow**, ranging from Florida to the Amazons, has the body partially covered with hair, the hind limbs absent, and the fore limbs flipper-like, with small nails. The nostrils, provided with valves, are placed on the end of a large and fleshy snout, and the neck is shortened, there being only six cervical vertebræ. It frequents estuaries and large rivers, wherever it finds growing the aquatic plants upon which it feeds, hence named an "herbivorous whale." Three species are recognized. Allied to the Manatee is the *Dugong*, of Australia and India, and a genus living on the coast of Kamtchatka in the last century, but now extinct.

FIG. 354.



Trich′ ĕ chus măn′ ă tus. Manatee. ($\frac{1}{70}$.)

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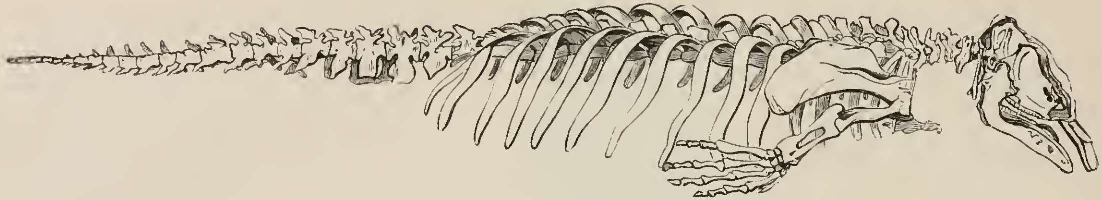
* The whale often descends to the depth of a mile, where, according to Scoresby, the pressure upon it is equal to 200,000 tons, and wood becomes so water-soaked as not to rise again. When, on being struck, the whale sinks to such a depth, the veins being unprovided with valves, the blood leaves the body through the wound in a continual hemorrhage, death soon resulting.

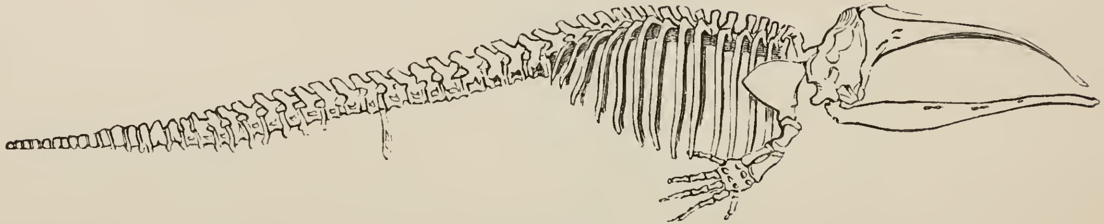
† This enormous bulk of fat is lighter than the water, and gives great buoyancy, so that the dead body of a whale floats until the layer of blubber is "flensed off," when it sinks.

Fig. 355.



Skeleton of a Manatee.

Fig. 356.

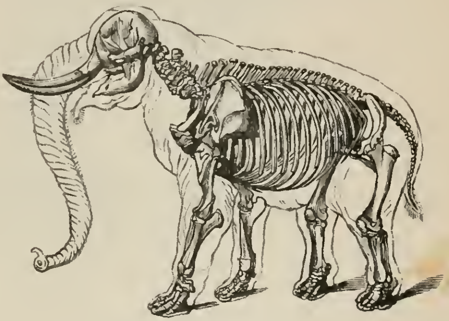


Skeleton of a Whale.

ORDER PROBOSCIDEA (prō bŏs sĭd′ĕ ȧ).

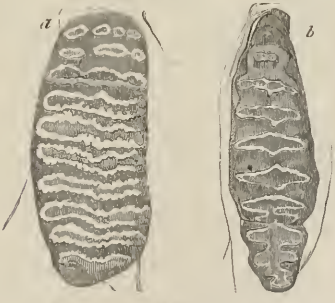
The **Elephant** is the largest of living quadrupeds, attaining eight to ten feet in height and 10,000 pounds in weight. It roams the forest in herds of twenty or more, and is supposed to live over one hundred years. The two upper incisors are prolonged into tusks, which serve for defense and for plowing up the ground to obtain succulent roots. The nose and upper lip are lengthened into a proboscis—the "trunk"—containing several thousand muscles, which permit every conceivable motion; while a mobile lip at the end is delicate enough to pick up a grain of wheat. This trunk enables the Elephant to reach its food, which it could

Fig. 357.



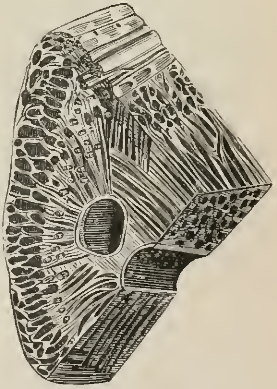
Skeleton of Elephant.

Fig. 358



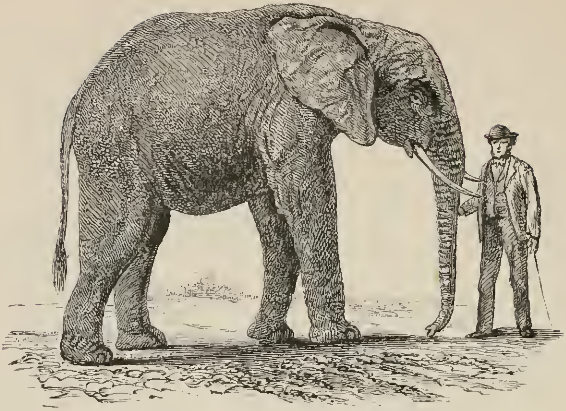
a, Tooth of Asiatic Elephant
b, Tooth of African Elephant.

Fig. 359.



Section of Elephant's trunk.

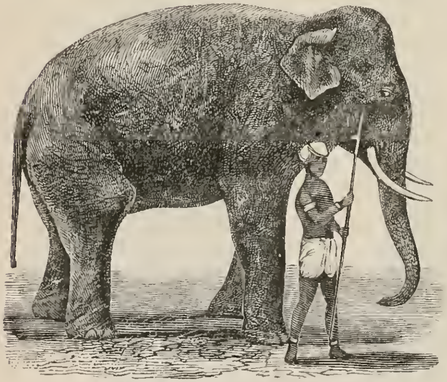
Fig. 360.



El' ĕ phas af ri cā' nus. African Elephant.

not do with its mouth, on account of its short neck and huge tusks. Water may be drawn into the trunk by suction, and then, the free end being inserted into the mouth, the draught forced out and swallowed. The *Asiatic* species is alone domesticated at the present day.* It

Fig. 361.



E. in' di cus. Asiatic Elephant.

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* Its intelligence is sometimes almost human. It can be taught to lay stone wall, and to pile logs uniformly, rolling them up an inclined plane. It is even intrusted with the care of young children, the huge nurse being lavish in its attentions, and when its charge crawls between its legs, moving with the utmost caution, and with its trunk carefully lifting the child out of the way. Tennant, in his work on Ceylon, says: "One evening my horse manifested uneasiness at a sound which approached us while we were traveling in the thick jungle. A turn in the road soon brought us to a tame elephant, without an attendant. It was carrying a heavy timber which it had balanced across its tusks, but the path

has a concave forehead, small ears, and the enamel of the teeth arranged in transverse bands. The *African* species has a convex forehead, enormous ears, and the enamel of the teeth lozenge-shaped. Both sexes have tusks, the male sometimes being six feet long and weighing a hundred pounds.

ORDER UNGULATA (ŭng gū lā′tȧ).

The distinguishing feature of this extensive order is, that the toe-nails form hoofs. Those having the number of toes even are styled *Artiodactyls*, and odd, *Perissodactyls*. The Artiodactyls (är shĭ ō dăk′tĭlz) that chew the cud are termed *Ruminants* (ro͞o′mĭ năntz). The digestive apparatus is complicated, since vegetable matter is ordinarily taken as food, and must be considerably changed before it can be assimilated by the animal tissues.

The several genera offer a great range of variety in structure as well as in habit; each characteristic, however, being dependent largely upon some peculiarity in a particular locality.

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being narrow, it was forced to bend its head so as to let the beam pass endways. The exertion and inconvenience led it to cry Urmph! Urmph! in a dissatisfied tone, and it was this sound which had alarmed my horse. The elephant, on seeing us halt, stopped, reconnoitered us for a moment, flung down the timber, and forced itself back into the brushwood to let us pass. As my horse still hesitated, the sagacious creature pressed still farther one side, repeating its cry of Urmph! in an encouraging tone, as if bidding us to come on. Finally my horse did so tremblingly, and when we were by, the elephant came out, lifted the timber, balanced it on its tusks, and resumed its march, snorting discontentedly as before."

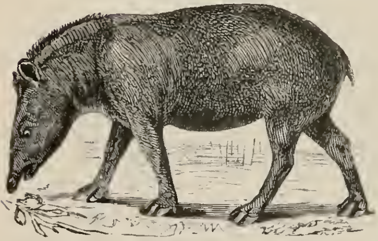
Mr. Hornaday says: "The elephant swims better than any other terrestrial quadruped," and in confirmation quotes from "Thirteen Years Among the Wild Beasts of India," by G. P. Sanderson, as follows: "A batch of seventy-nine" (elephants) "that I dispatched from Dacca to Barrackpur, near Calcutta, had the Ganges and several of its large tidal branches to cross. In the longest swim they were six hours without touching the bottom. After a rest on a sand-bank, they completed the swim in three more. Not one was lost. I have heard of even more remarkable swims than this."—"*Two Years in the Jungle*," Charles Scribner's Sons, 1886.

The order can be tabulated by a comparison of the hoofs and horns:

UNGULATA.	Pe ris so dac′tyl.	Three toes.			*Tā′ pĭr.* *Rhī nŏc′ ĕ ros.*
		One toe.			*Horse.*
	Artiodactyl.	Four toes.			*Pĕc′ că rȳ.* *Hog.* *Hĭp pō pŏt′ ă mus.*
		Two toes.	Ruminants.	Without horns.	*Camel.*
				Horns of solid bones, naked.	*Deer.*
				Horns of solid bones, covered with skin.	*Gĭ răffe′.*
				Horn core only of bone, shell persistent.	*Ox.*
				Horn core only of bone, shell deciduous.	*Prong-horn.*

The *Tapir* (tā′pĭr) links the artiodactyls and perissodactyls, its fore feet having four toes and its hind feet three. Flight being its only means of defense, the head, covered with hard skin and shaped like a conical wedge, is adapted for clearing a way through tangled brush-wood. The uniform black color of the South American Tapir is in striking contrast to the white back of the Indian.

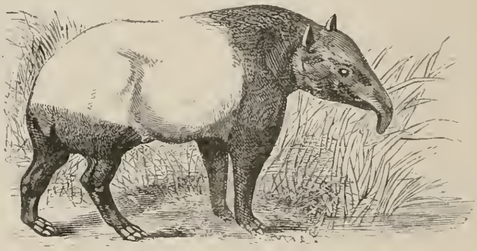
Fig. 362.



Tā′ pĭr us a mer i cā′ nus. ($\frac{1}{30}$.)

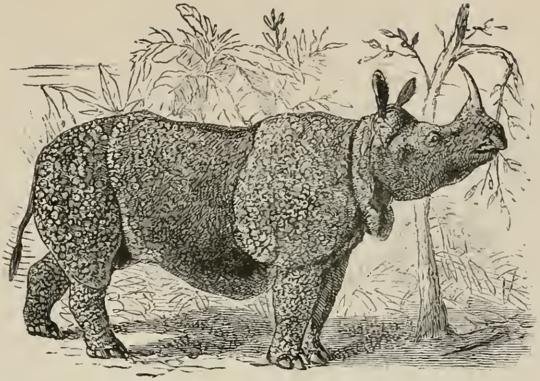
The *Rhinoceros* has a hard, naked, rough skin, laid in large folds, and so elastic that a bullet or spear-hole im-

Fig. 363.



Tā′ pĭr us bi cŏl′ or. Indian Archipelago. ($\frac{1}{30}$.)

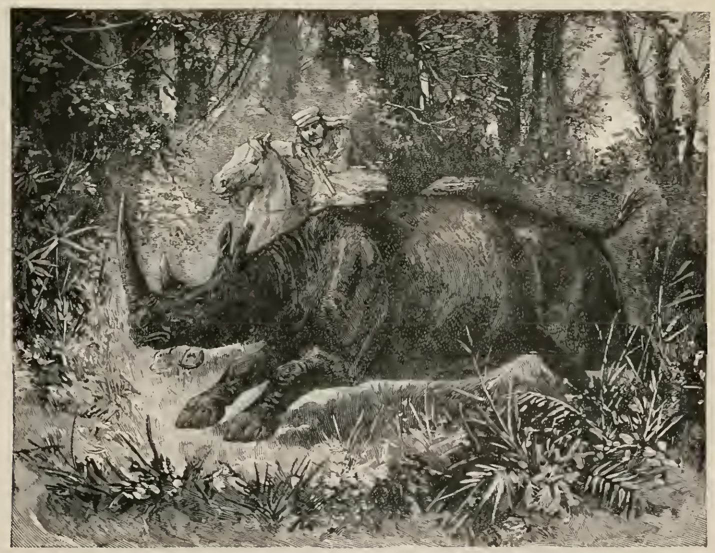
FIG. 364.



Rhi nŏc′ ros u ni cŏrn′ is. One-horned Rhinoceros. India ($\frac{1}{45}$.)

mediately closes, thus stanching the flow of blood. The horn is composed of agglutinized hairs, and being attached only to the skin, is movable; when, however, the

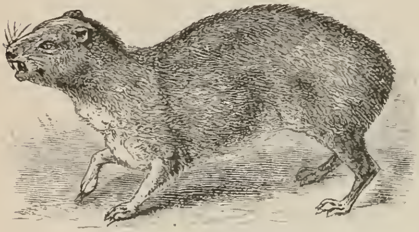
FIG. 365.



Rhi nŏc′ ĕ ros bi corn′ is. Two-horned Rhinoceros. Africa. ($\frac{1}{80}$.)

animal is enraged, it becomes fixed, as though part of the bone itself. Individuals attain the weight of 6,000 pounds.

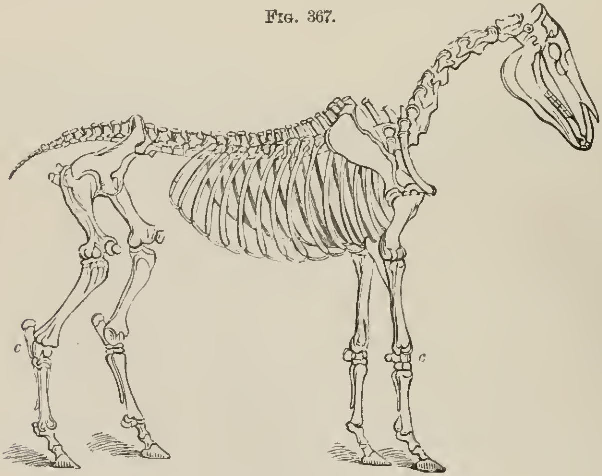
Fig. 366.



Hȳ′rax syr ĭ ā′cus. **Daman.** (⅙.)

Closely allied to the Rhinoceros in structure is the *Hyrax* (hī′răks), the only genus of the order *Hyracoidea* (hī-ră koid′ĕ ȧ). The *Daman* (dăm′ăn), in its various species, is a rabbit-like animal, found in Syria, Mozambique, and Southern Africa. A timid creature, it hides in the clefts of the rocks, and is, doubtless, the Coney (kō′nĭ) of Scripture (Proverbs xxx. 26).

Fig. 367.



Skeleton of Horse.

Animals allied in structure to the Horse have a single hoof* to each foot, the leg being so constructed as to allow the toes only to reach the ground.* Strictly herbivorous, with upper and lower incisors, they seem designed to crop after the ox, and in their turn to be followed by the narrow-jawed sheep with the cleft upper lip, enabling it to nibble where neither of the others could thrust its wide mouth.

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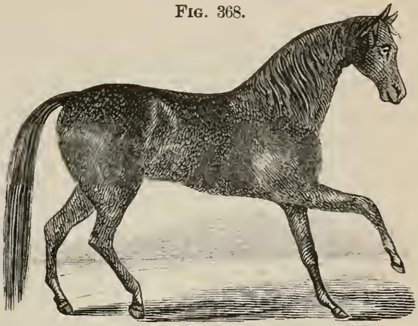
* This specialization not being often considered, what are more properly the wrists and ankles (*c*) are generally spoken of as the "knees."

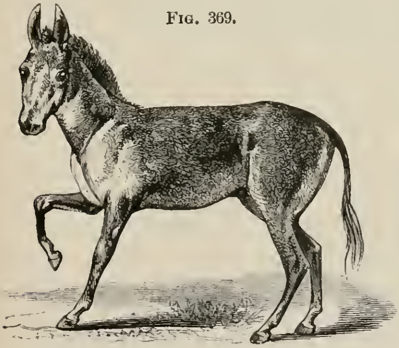
FIG. 368.



E′quus ca băl lus. Horse.

The *Horse* has been so diversified by domestication as to defy all attempts to trace its origin.† It is adapted to constant movement by having a simple stomach without a gall bladder, which permits uninterrupted digestion. Changing its coat of hair to suit the season, it is easily acclimated; in tropical regions the hair remaining short and sparse; in colder, lengthening to three or four inches, and thickening so as to become almost woolly.

FIG. 369.



E′quus ăs′ĭ nus. Wild Ass. ($\frac{1}{40}$.)

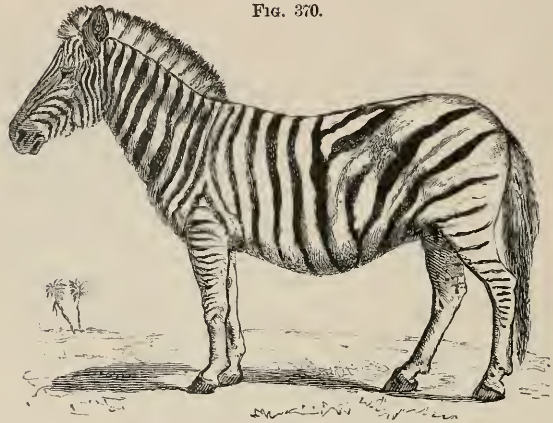
The *Ass* is generally employed by the peasantry throughout the East. Feeding upon coarser herbage than the horse, and being more patient under abuse, it is better adapted to be the slave of the poor.*

---

* The earlier fossil species had five, later ones four, and still later, three toes, two of which appear in our one-toed form, by the so-called splint bones.

† Careful research proves that there is not a distinctive Arabian breed—oftentimes considered the parent of the horse—any more than there is a Persian or an English one.

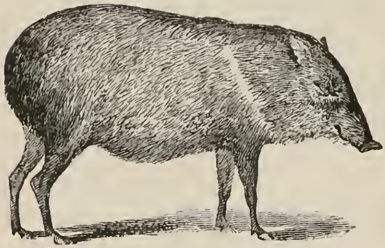
FIG. 370.



E′ quus zē bra. Zebra. ($\frac{1}{30}$)

The *Zebra* (zē′brȧ) is the most elegant of quadrupeds, but all attempts to domesticate it have failed.

FIG. 371.



Dī cŏt ў′ les tor quā′ tus. Peccary. ($\frac{1}{18}$)

The *Peccary* belongs to the warmer regions of the New World. There are but two species, the Collared and the White-lipped—the former living in families † and the latter in large herds, which in their migrations are very destructive to the crops. When wounded they are very ferocious, and all the rest will fight for the wounded one.

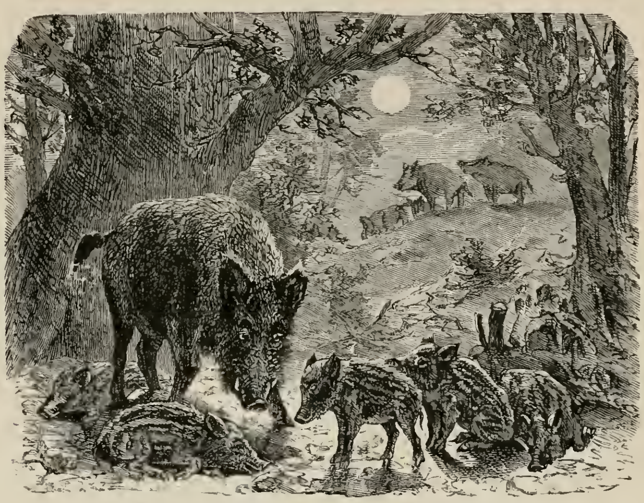
---

* It is common in European cities to see these animals driven every morning to the door of the sick, where they are milked

† The whole company of twenty or more are accustomed to back singly into a hollow log to sleep, the last one acting as a sentinel. This one being shot, the others successively take its place, so that, if skillfully managed by the hunter, the whole number may be captured.

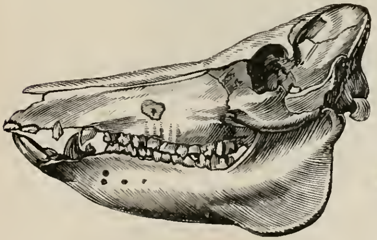
The *Hog's* skull is adapted to rooting in the ground for food. The lower canines project nearly horizontally, and being sharpened by friction upon the upper, constitute formidable weapons.

FIG. 372.



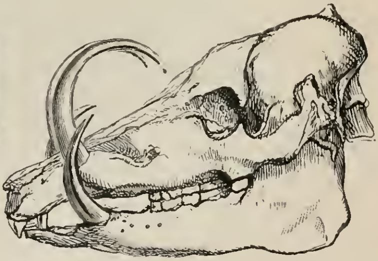
Sūs scrō'fa. Wild Boar. ($\frac{1}{32}$.)

FIG. 373.



Skull of Hog.

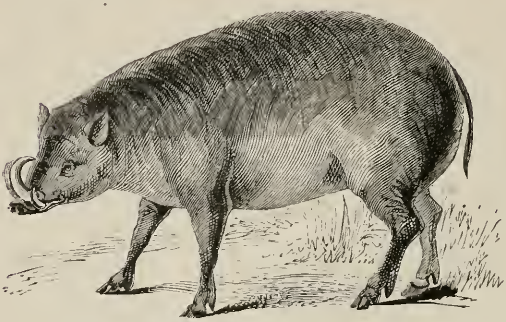
FIG. 374.



Skull of Babirusa. ($\frac{1}{78}$.)

The *Wild Boar* of the Old World is the parent of the domestic varieties and of the wild hogs of the New. The *Babirusa* (bā bĭ ro͞o′sȧ) found in Borneo, has its long upper canines recurved in a semicircle, thus serving, as the animal rushes through the bushes, to protect the eyes.

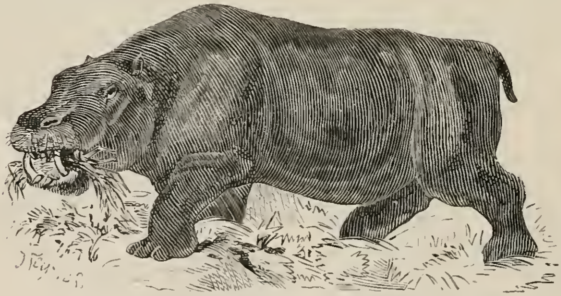
FIG. 375.



Sūs ba bi ru′ sa. **Babirusa Hog.** ($\frac{1}{20}$.)

The *Hippopotamus* of Africa is semi-aquatic, with horizontally-projecting lower incisors and strong vertical canines. A greedy feeder, it sinks to the bed of the sluggish stream, where it can remain six or eight minutes, digs up a quantity of aquatic vegetation, rises to the top, and, washing the mass, devours it while leisurely floating on the surface. It dredges the rivers, keeping

FIG. 376.

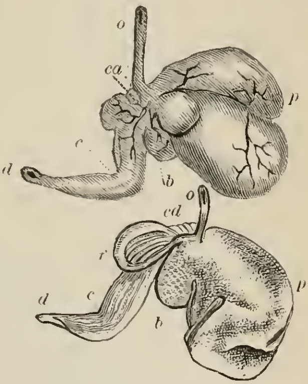


Hip po pŏt′ ă mus am phĭb′ ĭ us. **Hippopotamus.** ($\frac{1}{50}$.)

open the channels, so apt to become filled with the luxuriant growth of that tropical region.

The remaining Ungulates (ŭng′gū lātz), from the fact that they chew the cud, are called *Ruminants.* As these animals are largely preyed upon by carnivorous animals, and as mastication is a work of time, they fill a large stomach-reservoir by rapid grazing, re-chewing its contents in a place of security. The stomach is divided into four compartments. The food passes without mastication into the *rumen* (ro͞o′mĕn) [*p*], next into the *reticulum* (rē-tĭk′ū lŭm) [*b*], thence back through the œsophagus (ē sŏf′ă gus) [*o*] to the mouth, where it is masticated; then down the œsophagus a second time into the *leaflet* [*f*], and thence into the *caillette* (kī′yet) [*c*], or true stomach. The mechanism by which the food goes through the same orifice at the bottom of the œsophagus, at one time into the rumen and at another into the leaflet, may well create surprise. The œsophagus is continued below in a tube [*c a*], with a slit on the under side whose lip-like edges shut water-tight, forming a passage from the œsophagus to the leaflet. If, however, the mouthful of food swallowed be large and solid, as it is when first eaten, it distends the tube, and, separating the edges of the slit, falls into the first stomach; but if it be soft and pulpy, as it is after being re-chewed, it does not force apart the edges of the slit, and so reaches the third stomach. Here it undergoes further preparation,

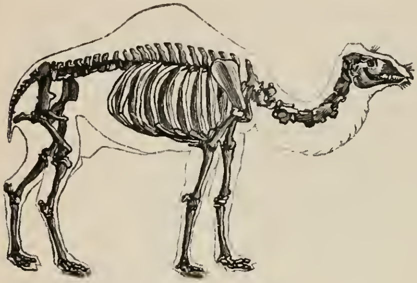
FIG. 377.



Stomach of a Ruminant.

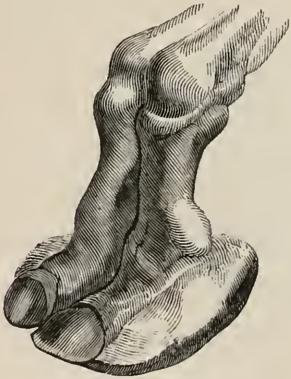
and passes directly into the fourth stomach, where the actual process of digestion is carried on. The mechanism for conveying the unchewed mass in the first stomach back into the mouth also depends upon the lip-like tube. The contraction of the walls of the rumen forces portions of the food into the reticulum; in turn, the contraction of its walls crowds a part against the outside of the lips, which, opening, pinch off a portion, and, compressing it into a ball, present it to the œsophagus, the fibers of which, contracting successively from below upward, push it forward into the mouth.

Fig. 378.



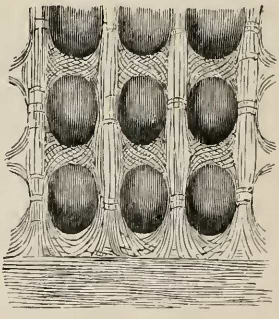
Skeleton of a Camel.

Fig. 379.



Foot of a Camel.

Fig. 380.



Water-cells of Camel's Stomach.

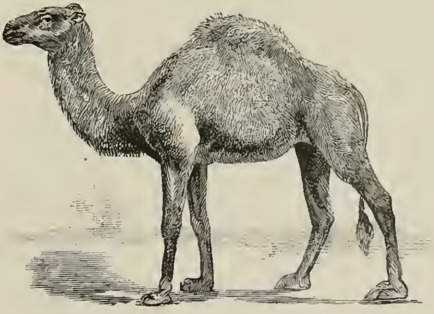
Each foot of the Camel is provided with two toes, united nearly to the point by a callous sole. In drinking, water passes directly to the second stomach, which, on becoming full, allows the overplus to reach a series of cells along the upper part of the first stomach. The contents of these latter is drawn on to supply the moisture necessary for digestion.

The family is tabulated as follows:

TOES UNITED TO THE NAIL.	One hump.	*Ca mē′ lus drom e dā′ ri us.*	Drŏm′ e dă ry.
	Two humps.	*Ca mē′ lus bac tri ā′ nus.*	Bactrian Camel.
TOES SEPARATED.	Without hump.	*Au chē′ nĭ a lla′ mȧ.*	Llä′ mȧ.

The *Dromedary* is peculiarly adapted to sterile regions. Its long neck, incisors and canines in both jaws, prehensile, cleft upper lip, and narrow cheek-bones, enable it to crop its food of thorny bushes by the wayside without retarding its speed; its hairy nostrils, which close intuitively, protect it from inhaling the particles driven by the simoom; its broad, cushioned foot prevents its sinking in the sand; its many-celled stomach enables it to go three or four days without suffering from thirst, and the gradual absorption of its fatty hump a still longer time without food; its callosities on the breast and joints permit its kneeling on the hard sand without abrading the skin; its projecting eye, sheltered from the sun by

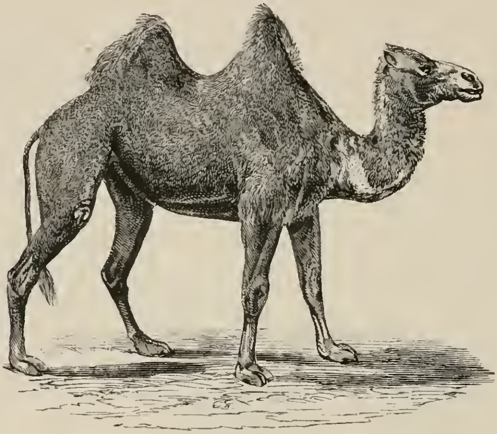
FIG. 381.



Ca mē′ lus drom e dā′ rĭ us. Dromedary. ($\frac{1}{60}$.)

an overhanging bony arch and long-lashed eyelids, and with the sight habitually directed to the path, gives surefootedness.*

FIG. 382.



Ca mē' lus bac trĭ ā' nus. Bactrian Camel. ($\frac{1}{80}$.)

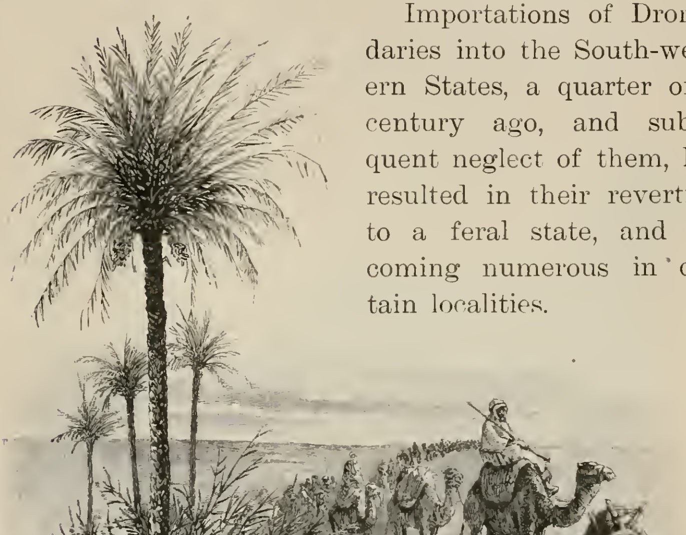
The *Bactrian Camel* has two humps, and is adapted by its more abundant coat to the colder climates, as the Dromedary is to the warmer. It is a native of Central Asia, where it is still found wild, though it is a disputed question whether such may not be runaways from a state of domestication.

---

* The Camel, poetically called by the Arab the "ship of the desert," constitutes his wealth. Its milk, and often its flesh, furnishes him food; its skin, leather; its hair, clothing; its excrement, fuel; and, in an extremity, the water in its stomach will save his life. It will carry 600 and even 1000 lbs. burden. A swift dromedary will travel 10 miles per hour for 20 hours on a stretch. Its gait has a peculiar swinging, jerking motion, that is terribly trying to the novice. Its disposition is said to be naturally gentle, but the brutality of its drivers often renders it ugly. Thus says a traveler: "Watch it when it is being loaded. See its keeper struggling frantically, and making it kneel only by sheer force, and when down, keeping it there by tying neck and fore legs together tightly. Hear it grumbling in deep, bubbling tones, with mouth savagely opened as each new burden is laid on its back. Look how it refuses to rise until a part is removed; then see it get up —a great, brown mountain, still groaning and bubbling—and dash to and fro, shaking off beds, furniture, and trunks, in a shower. Mark it, subdued by blows, march through the day, occasionally biting at a passer-by, and at night kneel to have its load removed, grumbling as ever. Certainly not the picture of our ideal patient animal!"

Importations of Dromedaries into the South-western States, a quarter of a century ago, and subsequent neglect of them, has resulted in their reverting to a feral state, and becoming numerous in certain localities.

Fig. 383.

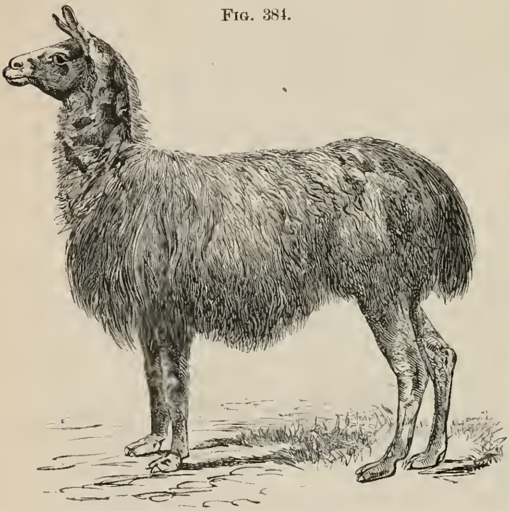


A Caravan. Camels being loaded.

The Arabs have cultivated different breeds of Dromedaries as they have horses, and with reference to the same characteristics,—speed and burden-bearing.

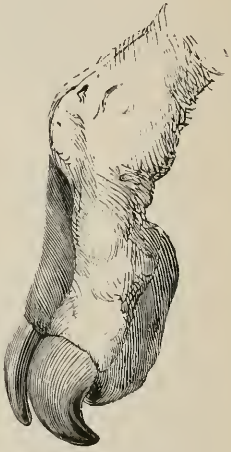
The *Llama*, representing the camel of the New World, is of small size and has no humps. To adapt it to its home in the Andes, its cushioned toes are completely divided, and its nails project so as to hook downward, and give it a secure hold among the crags.

Fig. 384.



Au chē′nĭ a llă′ma. Llama. ($\frac{1}{30}$.)

Fig. 385.



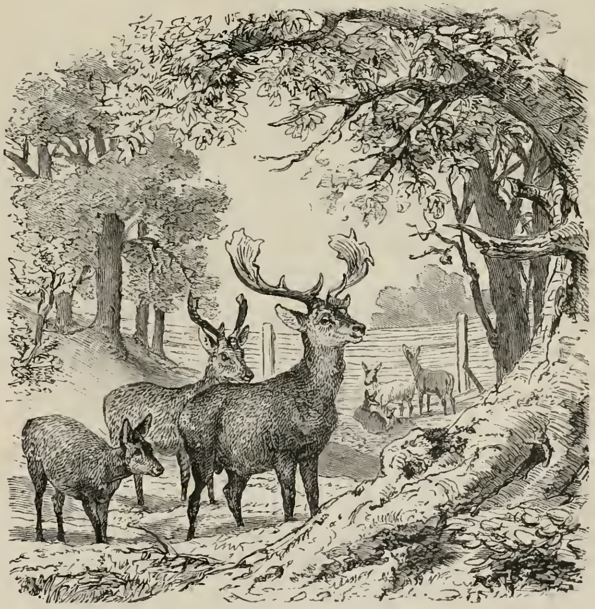
Foot of Llama.

The Deer family have solid, deciduous horns, which are cast annually, and at each renewal grow larger and more branching. In the adult, the horns first appear as cartilaginous outgrowths, and remain covered by a velvety skin. This is supplied with blood-vessels, until the ultimate branches are formed. Ossification now begins, and the arteries are constricted by a circular bur of bone round the base of each horn, which in its growth gradually shuts off the blood, that it may not by a sudden stoppage rush to the brain and produce apoplexy. The velvet, now deprived of its nourishment, soon withers, and is rubbed off, leaving the white horn beneath.

The family may be classified into genera by the conformation of the antlers.

DEER.	Horns developed.	CONICAL.	Bending forward.	*Cer' vus vĭr gin ĭ ā' nus.*	Deer.
			Bending backward.	*Cĕr' vus ca prē' ŏ lus.* *Cĕr' vus can a dĕn' sis.*	Roebuck. Wapiti
		PALMATED.	Moderately at tips.	*Cĕr' vus dā' ma.*	Fallow Deer.
			Broadly at tips.	*Rāng' ĭ fer căr' ĭ bou.* *Rāng' ĭ fer ta răn' dus.*	Caribou. Reindeer.
			Broadly.	*Al' cēs măl' chis.*	Moose.
	Horns not developed...................			*Mŏs' chus mos chĭf' er us.*	Musk Deer.

FIG. 386.

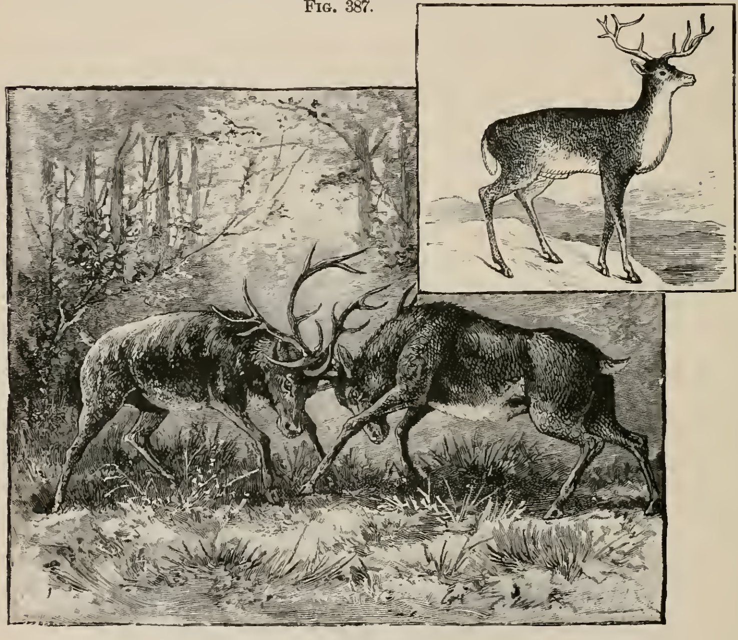


Cĕr' vus dā' ma. Fallow Deer. ($\frac{1}{32}$.)

The *Fallow Deer*, so called from its tawny brown color, is the domesticated species of the English parks. A large buck takes the lead of the herd, and suffers none but a few favorites to approach his regal presence.

The *Virginia Deer* is the common Deer of the United States. It differs in size according to locality, the Southern specimens being smaller.* Its antlers bend forward, with varying prongs. The males while fighting sometimes interlock their antlers, and unable to release themselves, perish miserably. The spotted young are called Fawns, and may be easily domesticated. The sagacity of the Deer is shown in taking to the water when hunted with dogs, its greater height giving it a footing, while they, compelled to swim, are comparatively helpless.

Fig. 387.

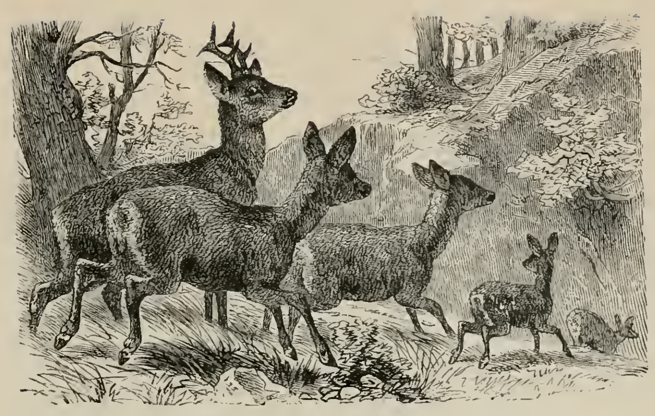


Cĕr′ vus vir gin ĭ ā′ nus. Virginia Deer. ($\frac{1}{30}$.) Deer Fighting.

---

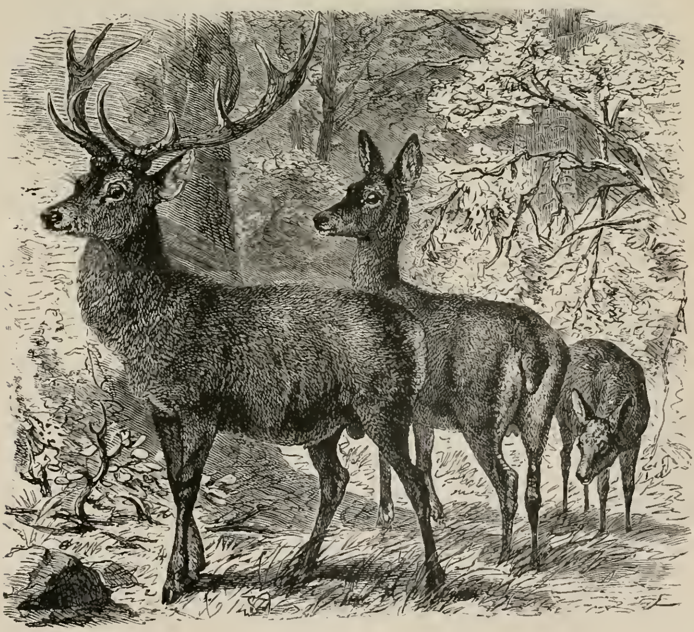
* The Deer is a great destroyer of rattlesnakes, cutting them to pieces, by alighting upon them with all four feet.—Its skin is tanned by the Indians by pounding in a solution of its own brains, and is known as "buck-skin."

FIG. 388.



Cĕr′ vus ca prē′ ŏ lus. Roebuck. ($\frac{1}{24}$.)

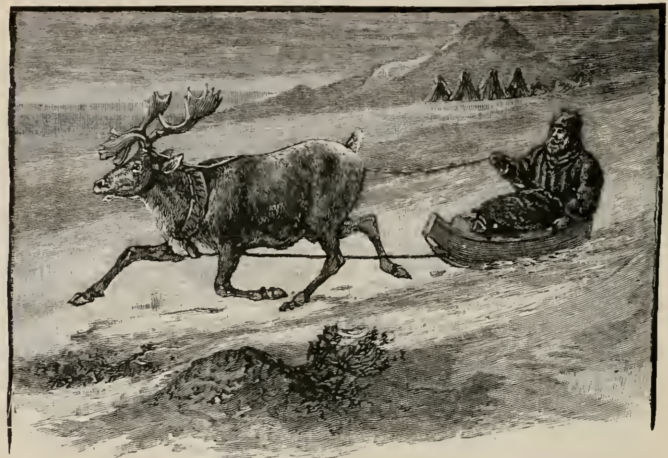
FIG. 389.



Cĕr′ vus can a dĕn′ sis. Wapiti. ($\frac{1}{30}$.)

The *Roebuck* (rō′ bŭk), marked by its white haunches, is the smallest of the British Deer. Its short, straight horns are divided into three branches. Unlike other deer, it pairs for life, and lives in families.

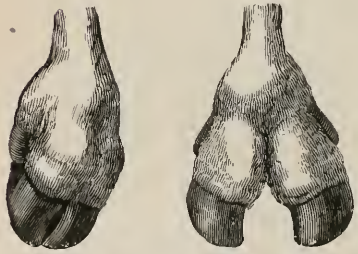
Fig. 390.



Rāng′ ĭ fer ta răn′ dus. Reindeer. ($\frac{1}{48}$.)

The *Wapiti* (wăp′ĭ tĭ), or *American Elk*, a congener of the red deer or stag of Northern Europe, has long, branching conical horns, sometimes six feet apart at the tips.

Fig. 391.



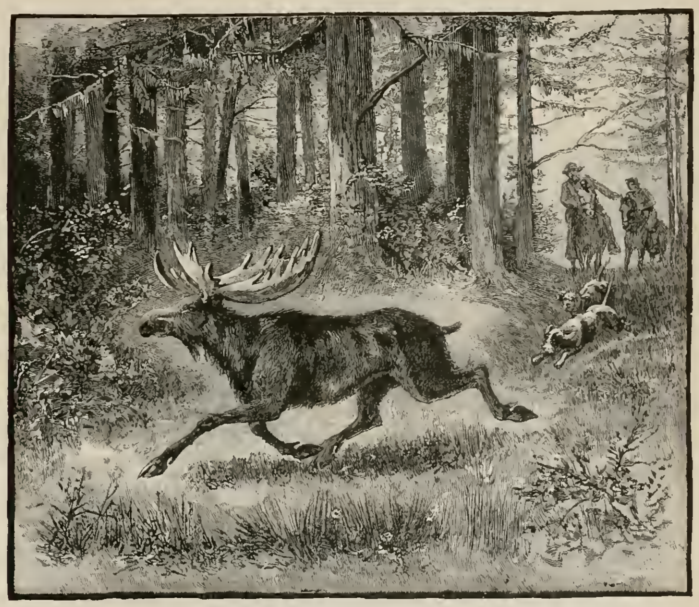
Hoof of Reindeer. Closed and open.

The *Reindeer** has widely-spreading hoofs, as a special provision for traveling on the snow; while to give a secure hold upon the crags, the toes of the closed foot are firm and pointed. In summer, it subsists upon Arctic shrubs, and in winter, upon moss, which it detects under the snow by its keen smell, and digs up with the palmated tips of its antlers.*

---

* The Caribou (*kăr′ ĭ bōō*) of North America is by some considered identical with the Reindeer of Lapland, and, if domesticated, would doubtless, in a few generations, show as many varieties.

Fig. 392.



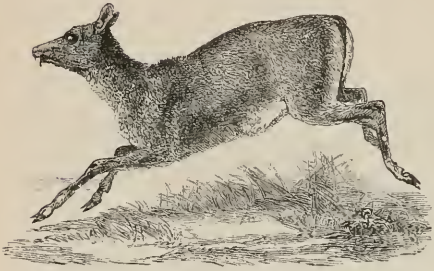
Ăl′ cēs măl′ chis. **Moose.** ($\frac{1}{40}$.)

The *Moose*, once abundant in the northern parts of North America, is now becoming extinct. Its broad, palmated horns, weighing fifty to sixty pounds, are used in bending down boughs and plowing up the snow. The tender branches of small trees are often obtained by the animal's riding down the main stem. For defense it relies upon its horns and rapid blows with its fore feet, a stroke of which has been known to kill a wolf. Its pace is a quick trot, the feet being lifted so as to pass over fallen trees or other obstructions without apparent change of gait.

---

* Harnessed to a sledge, with only a collar and a trace passing between its legs, and guided by a single rein attached to its neck, the Reindeer easily draws its master over the snow a hundred miles a day. It has been known to run nearly 19 miles in an hour and 150 in 19 hours. To the Laplander, it is at once horse, cow, and sheep. Its horns supply tools; its hide and hair, clothing; and its flesh and milk, food. Without it Lapland would be uninhabitable. The inhabitants reckon their wealth by their reindeer, as the Arabs do by their camels. A rich Laplander owns one thousand or more.

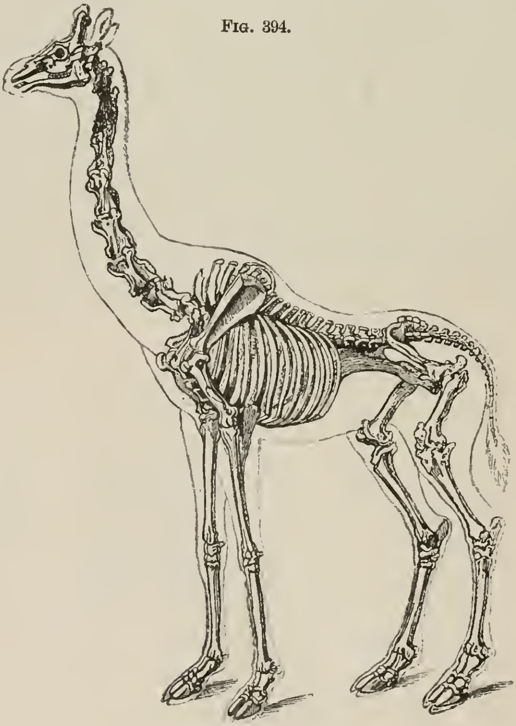
Fig. 393.



Mŏs' chus mos chĭf' ĕ rus. Musk Deer. ($\frac{1}{24}$.)

The *Musk Deer* of Thibet has no horns, the male

Fig. 394.

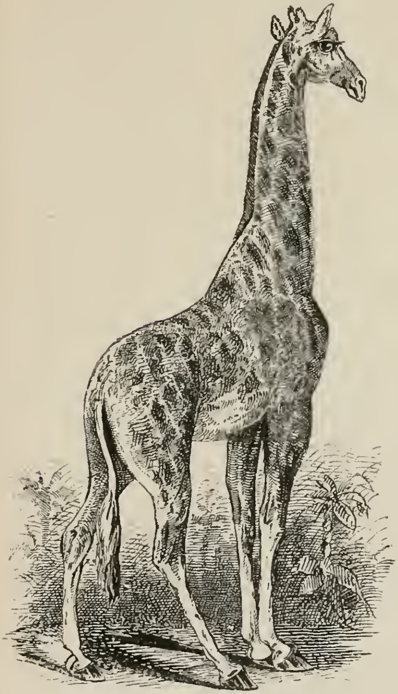


Skeleton of a Giraffe.

having two sharp projecting upper canines. It furnishes the musk of commerce, which it secretes in a kind of sac.

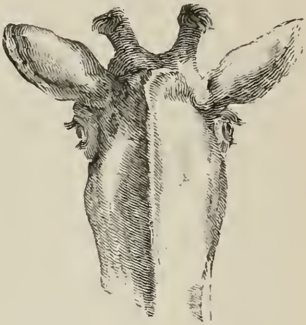
The *Giraffe* (ġĭ răf′) inhabiting the arid regions of Africa, where herbage quickly disappears after the rainy season, is adapted by its long neck* to browse upon the branches of trees. There is an apparent difference in the length of the fore and hind legs; but the heads of the humerus and femur are on a level, and the great height of the fore-shoulder is caused by the length of the scapula

FIG. 395.



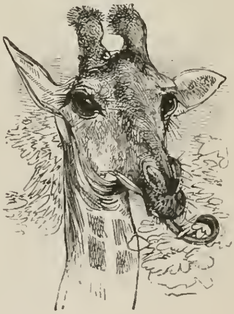
Ca mel o păr′ dă lis gi răf′ fa. Giraffe. ($\frac{1}{60}$.)

FIG. 396.



Giraffe's head from the back.

FIG. 397.



Head of a Giraffe, showing tongue.

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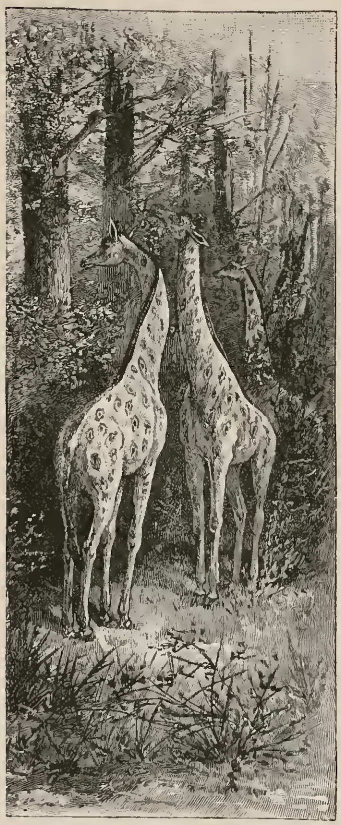
* Seven—the typical number of cervical vertebræ for all mammals—is not, however, varied from.

and the spinous processes of the vertebræ. As its greatest enemy is the low-crouching lion, that usually springs upon its prey from behind, its eye is so placed on the side of the head, that it can see backward as well as forward; and, as the danger is from below, while its food is above, the sensitive tufts on the tips of its skin-covered horns indicate, as it stalks among the trees, the presence of leaves overhead. Its chief reliance for defense is on rapid and powerful kicks—sufficient to break the skull of a lion. The tongue is prehensile and capable of lateral expansion, as well as of great elongation. Its colors harmonize with the branchless trunks among which it stalks.*

Fig. 398.



Giraffes feeding.

The *Ox* family includes those ruminants which have the horns covering bony cores as shells, which, with a single exception, are persistent. Usually the females, as well as the males, are thus armed.

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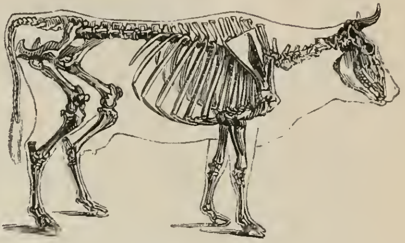
* "In the case of the Giraffe, which is invariably met among venerable forests, where innumerable blasted and weather-beaten trunks occur, I have repeatedly been in doubt as to its presence, until I had recourse to my spy-glass; and on referring the case to my savage attendants, I have known even their optics to fail, at one time mistaking these dilapidated trunks for camelopards (*kà mĕl′ ŏ pardz*) and again confounding real camelopards with these aged veterans of the forest."—*Cumming's Adventures.*

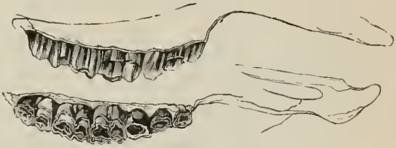
Great range in variety of form and habit is exhibited.

FIG. 399.



Skeleton of a Cow.

FIG. 400.

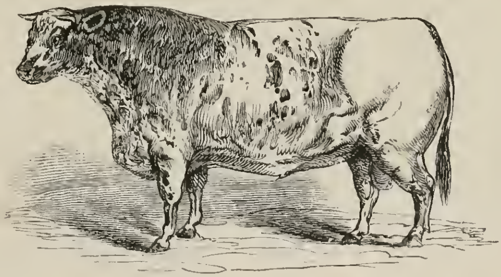


Teeth of Herbivora.

The *Domestic Ox* evinces no trace of its origin, or that of its numerous varieties. Endowed by the Creator with inherent qualities adapting the genus to easy acclimation, it is every-where found the companion of civilized man. There are in this country three noted breeds, each distinguished for peculiar excellencies.*

The *Short Horn*, or *Durham*, from Durham County, England, is pre-eminent for beef. The *Jersey*, from the island of Jersey, is unrivaled for the quality, and the *Ayrshire* (ār′shĭr), from Ayrshire, Scotland, for the quantity of its milk.

FIG. 401.



Bŏs tau′ rus. Short Horn.

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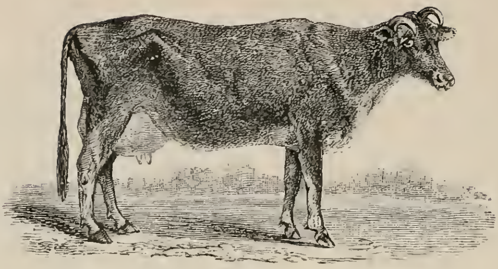
* A careful study of Figs. 401, 402, and 403, will clearly define the points of distinction in these varieties, and enable the student to identify each in a herd or at a Fair.

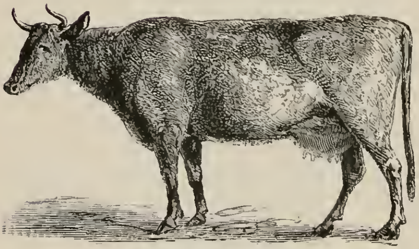
Fig. 402.



Jersey.

A wild breed, pure white in color, but with red ears and brown muzzle, is still preserved in the park of Chillingham, England.

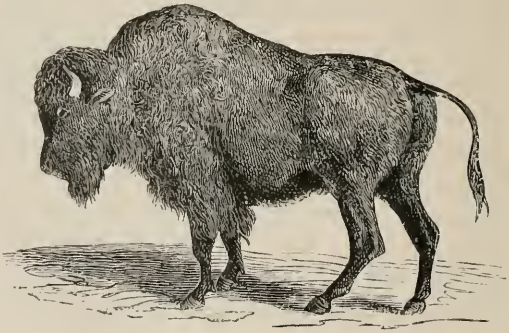
Fig. 403.



Ayrshire.

The *Bison* (bī′sŏn) is the only bovine (bō′vīn) [note generic name of family], except the Musk Ox, indigenous to this country.* Originally ranging in immense herds over the greater part of North America, it is now said to be found only in the southern portions of British Columbia; except a small herd preserved in Yellowstone Park by order of the Govern-

Fig. 404.



Bŏs a mer i cā′ nus. Bison. (1/40.)

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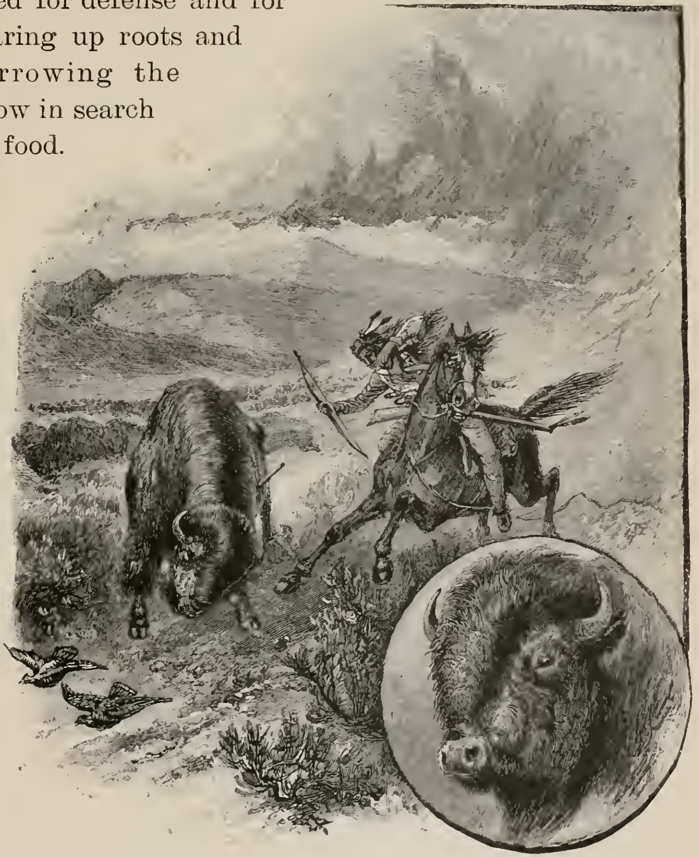
* Having the distinctive hump on the fore-shoulders, it is a true Bison and not a Buffalo, as it is generally called.

ment. The old males sometimes weigh nearly a ton, and though so bulky, are nevertheless fleet. Their short, slightly curved horns are used for defense and for tearing up roots and furrowing the snow in search of food.

Fig. 405.

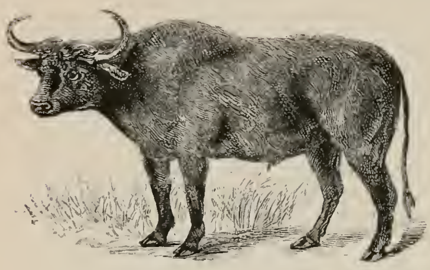


Hunting the Bison.

The Bison is easily domesticated if taken in hand sufficiently young, as proven by the attempts now being made in that direction by the warden of the State Prison, at Stony Mountain, Manitoba.

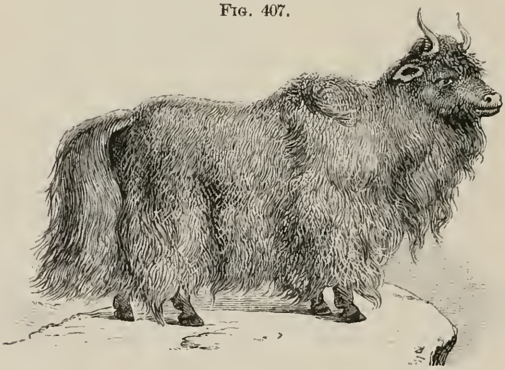
The *Indian Buffalo*, originally an inhabitant of Southern Asia, though an animal quite different from the docile ox, has, through the agency of man, become distributed as a beast of burden, to the Pacific on the east and the Atlantic on the West. Through neglect it has become semi-wild in many localities of Southern Europe, yet it may often be seen with a ring in its nose, slowly toiling about the Italian towns, and even in the Campagna of Rome.

FIG. 406.



Bŏs bū bă lus. Buffalo.

FIG. 407.

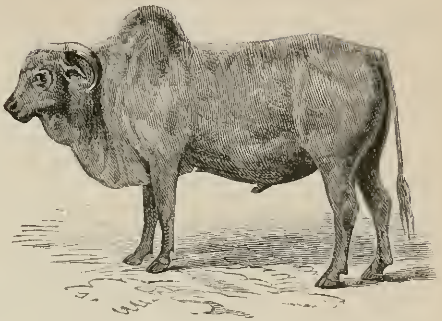


Bŏs grŭn′ nĭ ens. Yak. ($\frac{1}{40}$.)

The *Yak* (yăk), or *Grunting Ox*, is found both wild and domesticated in Central Asia. Its characteristics are so modified by subjugation as to produce many tame varieties; but its great development of hairy covering proves its adaptation to the colder climates.

The *Zebu* is a beast of burden on the eastern coast of

Fig. 408.

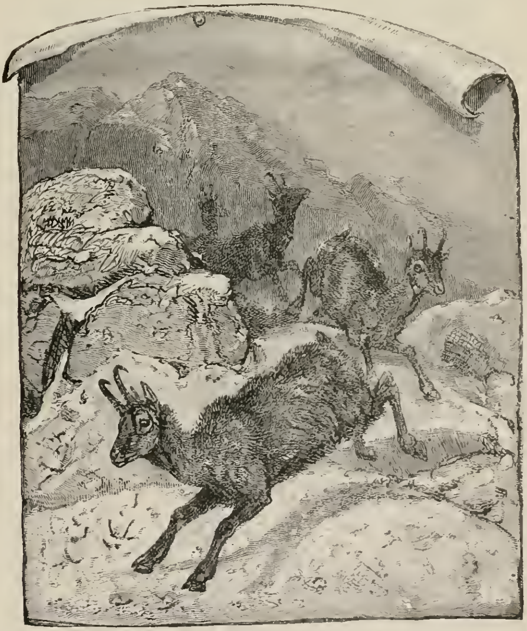


Bŏs ĭn' dĭ cus. Zebu. ($\frac{1}{40}$.)

Africa, in the Indian Archipelago, and throughout Southern Asia.*

The *Chamois* (shăm′mў) inhabits the Alps, living in small flocks upon the giddy heights where the eye can scarcely detect a standing-place. Springing diagonally down an almost perpendicular rock

Fig. 409.



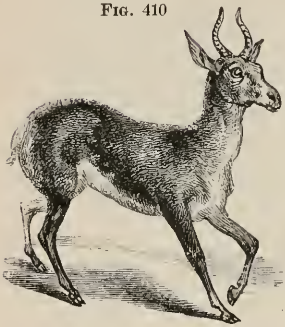
An tĭl' ŏ pe ru pĭ cā' prȧ. Chamois. ($\frac{1}{36}$.)

---

* It is not a Bison, though it has the distinctive hump, for the Bison's consists of muscles that move the head, while the hump of the Zebu is composed of fat.

and striking the face of the cliff three or four times with its feet, it will land securely at the desired point.* At a suspicious sound, a flock will stand for an incredible time as quiet as the rocks around them; but at a signal of danger from the sentinel, all are away with the speed of the wind.

Fig. 410

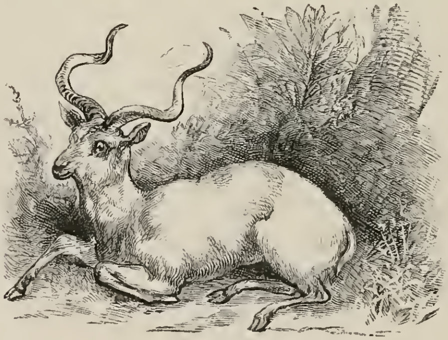


A. dŏr′ cas. Gazelle. ($\frac{1}{36}$.)

The *Gazelle* (gȧ zĕl′) has an elegant form; black, round, and thick horns; large, dark, and lustrous eyes;† and a swiftness so great that the greyhound can not overtake it, unless it halts through curiosity to face the dogs.

The *Koodoo* (ko͞o′do͞o) is characterized by its curiously twisted horns. It inhabits South Africa, and is exceedingly handsome and graceful.

Fig. 411.



A. kŭ dū. Koodoo. ($\frac{1}{50}$.)

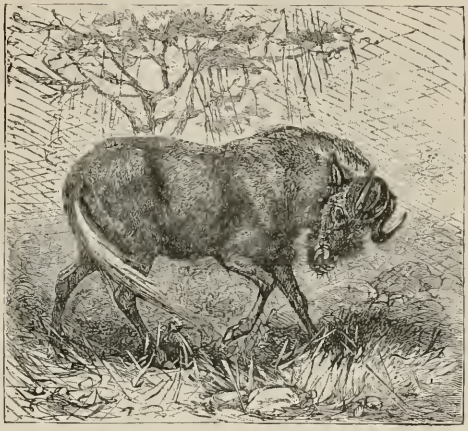
---

* Though Chamois-hunting among the Alpine fastnesses is attended with great peril, so that in one instance, father, son, and grandson, successively perished in the pursuit, yet the occupation is so fascinating as to be rarely relinquished.

† These are so proverbially beautiful as to give rise to the expression "gazelle eyed." (See Moore's "Lalla Rookh." —"The Fire Worshipers.")

The *Gnu* (nū), [*Common* and *Brindled*], resembles the horse, buffalo, and deer. It is, however, a bovine antelope.*

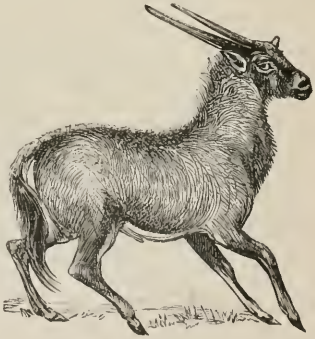
FIG. 412.



A. gnū. Gnu. ($\frac{1}{40}$.)

The *Oryx* (ō′rĭks), or *Gemsbok* (ḡĕmz′bŏk), is sometimes called the "*Unicorn*," as its straight horns, seen in profile, so exactly cover each other as to seem but one. It is the only antelope that defends itself against the lion; receiving its enemy on the point of its sharp horns, which serve as natural bayonets.

FIG. 413.

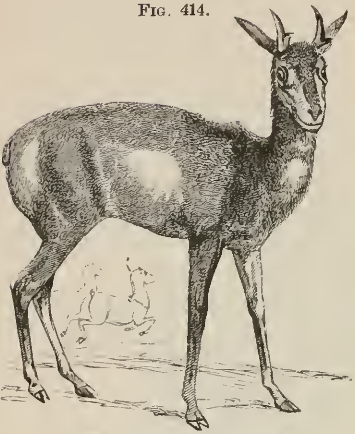


A. ō′ryx. Gemsbok. ($\frac{1}{30}$.)

* "Gnus live in herds, often mixing with Ostriches, Zebras, and Giraffes, in one great mass. When alarmed they spring up, and whisking their long white tails, pursue one another at full speed, pawing, kicking, and the bulls fighting and tumbling down at every shock. This strange conduct has given them the name of Wildebeeste, among the Dutch settlers. Gnus are so timid, that at the first sight of a strange object, they will set off as if half-crazy with fear, but their curiosity soon leads them to return to inspect it, though at the risk of their lives. A hunter, by merely tying a red

Unlike those of other Antelopes, the horns of the *Prong-horn* are deciduous. The core, however, is not exposed, but is protected by a growth of stiff hairs.

Fig. 414.

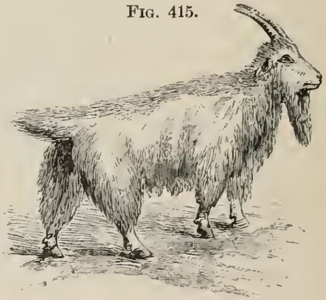


An tĭl o cā' pra a mĕr i cā' na.
Prong-horn. ($\frac{1}{24}$.)

The *Mountain Goat* is extremely rare, though sometimes found on the higher slopes of the Rocky Mountains. It has small, jet black, ringed horns, and long white hair.

The *Mountain Sheep*, found wild on the Rocky Mountain slopes, has a convex forehead, horns directed backward, then spirally forward, and two kinds of hair, one being crimped. It feeds on grassy knolls surrounded by craggy rocks, to which it retreats when attacked by wolves Its horns sometimes grow so long and curve so far downward and forward, that it can not graze on level ground. It was formerly supposed to inhabit only the higher and more inaccessible cliffs; but more recent explorations have found it at home in the Bad Lands about the sources of the Missouri and Yellowstone rivers.

Fig. 415.

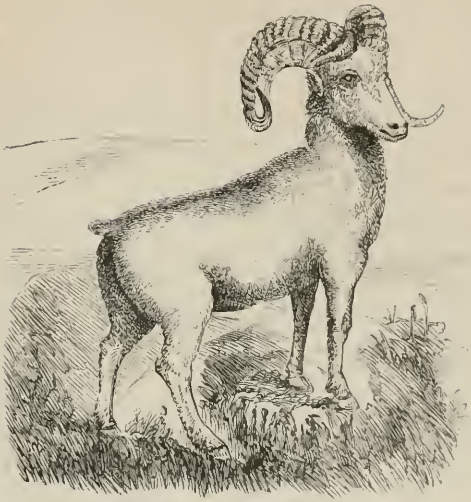


A plo cē' rus mon tā' nus.
Mountain Goat.

---

handkerchief to the muzzle of his gun, has thus enticed a herd within musket range. He must look out, however, lest they charge down upon him so savagely as in turn to put him to flight."—*Wood.*

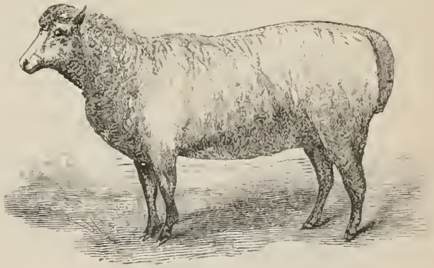
FIG. 416.



O′vis mōn tā′ na. Mountain Sheep. ($\frac{1}{24}$.)

The *Domestic Sheep* exhibits no less than forty well-marked varieties, and yet so shading into one another, that all have doubtless originated from a common stock.* Its sharp, chisel-like incisors and cleft upper lip enable it to bite closer than the Ox, and thus procure sustenance where that animal would starve. The Goat, in defending itself, rears upon its hind legs, and comes down head first upon its opponent with the weight of

FIG. 417.



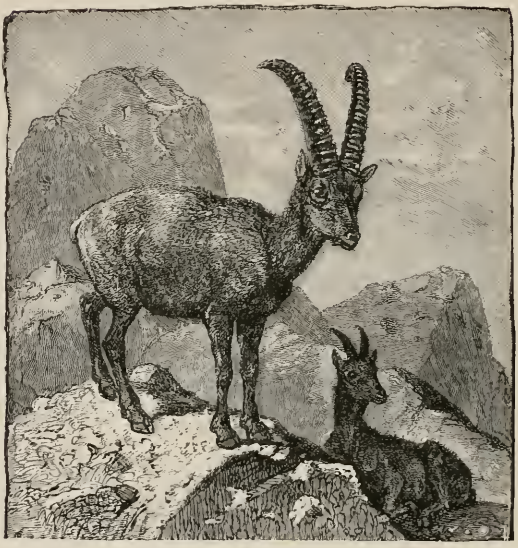
O′vis ā′ rĭ es. Sheep.

---

* The influence of climate is remarkably shown in the tendency of the Merino breed to develop an additional pair of horns when transferred from Spain to Peru. A breed found in Syria have tails weighing from seventy-five to a hundred pounds.

its body; the Sheep runs forward and butts with the combined force of its weight and impetus.

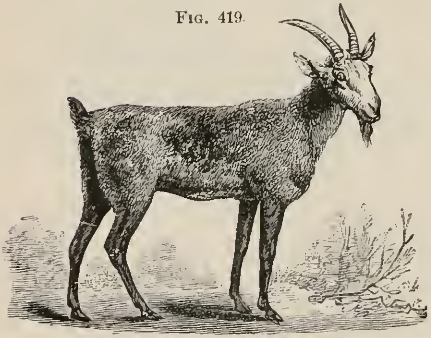
FIG. 418.



Cā'pra ī'bex. Ibex. ($\frac{1}{30}$.)

The *Ibex* differs from the Goat in having longer and stronger horns, with two longitudinal ridges instead of one, and their transverse markings knotted.

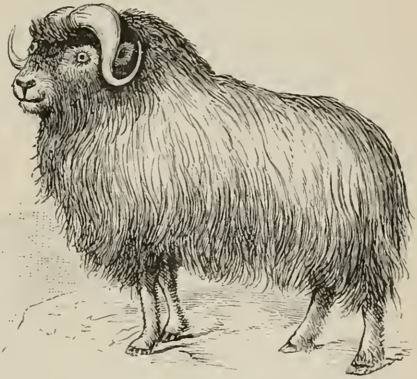
FIG. 419.



Ca'pra æ ga'grus. Goat. ($\frac{1}{20}$.)

The *Goat*, notwithstanding its diversity in form, color, shape of horns, and in fineness of hair—which in some species approximates wool—possesses characteristics bringing it into the unity of a genus. It is an indiscriminate feeder, thriving upon many plants that are poisonous to other ruminants, and thus serves in the great creative scheme to diminish weeds that would become excessive in grazing districts.* It is the cow of the European peasantry, a pair often yielding half the support of a family.

Fig. 420.



O' vĭ bos mos chā' tus. Musk Ox. ($\frac{1}{24}$.)

The Goat inhabits the lower stage of mountain slopes, the Chamois, the middle, and the Ibex, the highest.†

The *Musk Ox*, so called from the flavor of its flesh, inhabits Arctic North America.‡ It feeds on grass and lichens. The horns widen at the base, so as entirely to cover the crown of the head.

ORDER CARNIVORA (kär nĭv'ŏ rȧ).

To this order belong those animals which are flesh-eaters. While some, like the Lion and Tiger, are strong, agile, and with the special senses highly developed, others, like the Walrus and some of the Seals, are timid and retiring, falling an easy prey to their enemies.

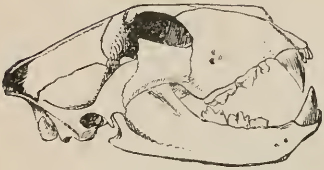
---

* It prefers steep and solitary places, leaping singly, or even when two are tied together, across frightful chasms, and always alighting in concert at the desired spot. If two meet in a narrow path, one will lie down and the other walk over its back.—Cashmere shawls, kid gloves, morocco leather, goat's-hair wigs, and rock venison, are luxuries derived from these humble but useful animals.

† The story of the Ibex throwing itself from lofty precipices and landing upon its horns is considered a myth, though often reported by the earlier Naturalists.

‡ The Esquimaux hunters will attack this irritable animal with only a knife, and turning around quicker than it can wheel, stab it to death.

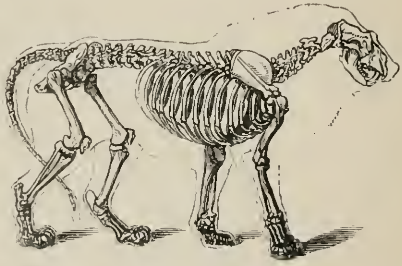
Fig. 421.



Skull of a Carnivorous Animal.

Among their anatomical peculiarities are (1), their dentition, marked by long, sharp, canine teeth, the last molar on each side, above and below, being larger and sharper than the others, used for crushing bones, and known as the "carnivorous tooth"; and (2), their feet, which are, in the more typical forms, provided with toes armed with sharp claws. These anatomical peculiarities afford the basis of a classification.

Fig. 422.

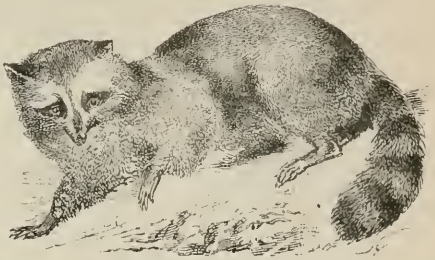


Skeleton of a Lion.

CARNIVORA.	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{4-4}{4-4'}$	$\frac{2-2}{2-2}$	.... Claws non-retractile.	*Raccoon-fox.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{4-4}{4-4'}$	$\frac{2-2}{2-2}$	.... Claws non-retractile.	*Raccoon.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{4-4}{4-4'}$	$\frac{2-2}{3-3}$	.... Claws non-retractile.	*Bear.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{2-2}{3-3'}$	$\frac{2-2}{2-2}$	.... Claws non-retractile.	*Weasel, etc.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{3-3}{4-4'}$	$\frac{3-3}{3-3}$	...... Claws non-retractile.	*Dog, etc.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{3-3}{3-3'}$	$\frac{2-2}{1-1}$	.... Claws non-retractile.	*Hȳ ē' na.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{3-3}{4-4'}$	$\frac{3-3}{2-2}$	.... Claws semi-retractile.	*Civ'et.*
	$\frac{6}{6'}$	$\frac{1-1}{1-1'}$	$\frac{2-2}{2-2'}$	$\frac{2-2}{1-1}$	.... Claws retractile.	*Lion, etc.*
	$\frac{2}{0'}$	$\frac{1-1}{0-0}$	indefinite ...		.... Claws on posterior feet only.	*Walrus.*
	$\frac{6}{5'}$	$\frac{1-1}{1-1}$	......	$\frac{5-5}{5-5}$	.... Claws on posterior feet only.	*Eared Seal.*
	$\frac{6}{4'}$ or $\frac{4}{4'}$ or $\frac{4}{2}$	rudimentary		$\frac{5-5}{5-5}$	Claws on all the feet.	*Seal.*

The *Raccoon-fox* of Mexico, and the south-west portions of the United States, is raccoon-like in appearance and habits, but differs in the length and size of its banded tail, and its more arboreal life. The California miners make it a domestic pet.

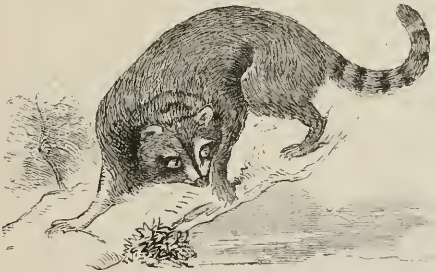
FIG. 423.



Băs' să ris as tū̆' ta. Raccoon-fox.

The *Raccoon* is the only representative of its family in the United States. It derives its specific name from its habit of dipping its food in the water before eating. Though its entire foot is naked, yet in walking it does not bring its whole sole to the ground. Omnivorous in its food, it is, according to circumstances, a fisher, a hunter, a trapper, a reaper, or a fly-catcher, having the instinctive cunning of the fox, the inquisitive meddlesomeness of the monkey, the greediness of the bear, and the slyness of the cat.

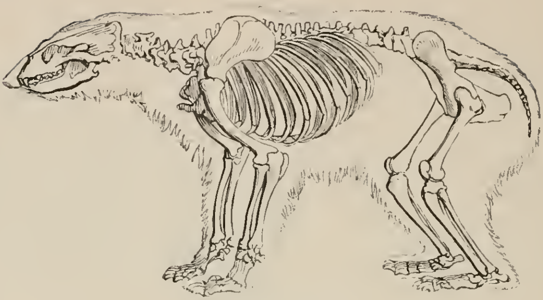
FIG. 424.



Prō̆' cy̆ on lō' tor.
Raccoon, or Common "Coon." ($\frac{1}{16}$.)

The *Bear* is a typical example of a plantigrade (see Glossary). The entire sole of the foot applied to the ground; the broad flat crowns of the molars; large, curved, non-retractile claws; smooth tongue; mobile nose; circular pupils, and short tail, exhibit such variations from the strictly carnivorous animals as betoken different

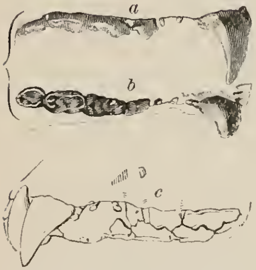
Fig. 425.



Skeleton of a Bear.

habits of life. Bears are carnivorous only from necessity, their preference being for roots, nuts, honey, and even insects. Neither species will ordinarily attack a man, and the traditional hugging to death of their victim, started probably from their habit of holding their prey, as a pig for instance, between their fore-paws and breast, and walking off with it, for a short distance, on their hind-legs. The single American genus is thus tabulated:

Fig. 426.

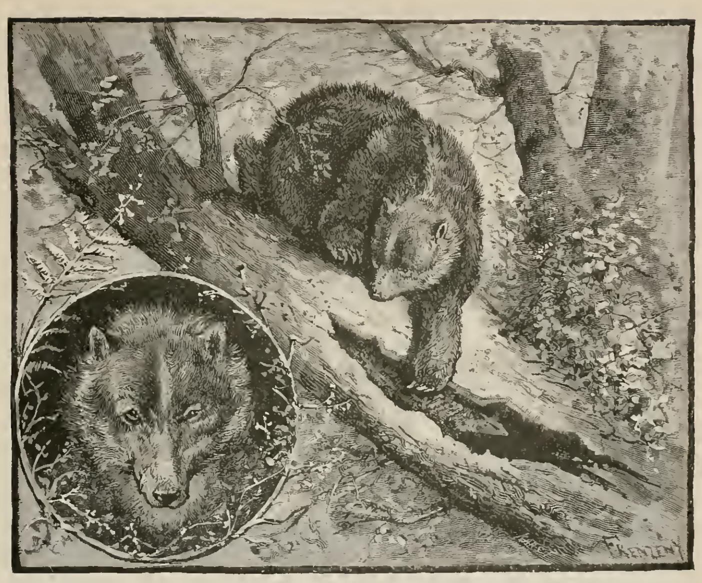


a, Side view of Bear's upper jaw.
b, Top view of Bear's lower jaw.
c, Side view of jaws shut.

Terrestrial and arboreal.	Soles of the feet naked.	*Ur′ sus a mer i cā′ nus.*	Black Bear.
Terrestrial only.		*Ur′ sus hor rĭb′ i lis.*	Grizzly Bear.
Maritime	Soles of the feet covered with hair.	*Ur′ sus mar i tī′ mus.*	White Bear.

While the following species is limited to the Rocky Mountain regions, the *Black Bear*, under a variety of names, is distributed over North America. It feeds on berries, acorns, and succulent vegetables; and will occasionally raid the farmer's pig-sty. It is also known to climb trees for honey, of which it is very fond. In the

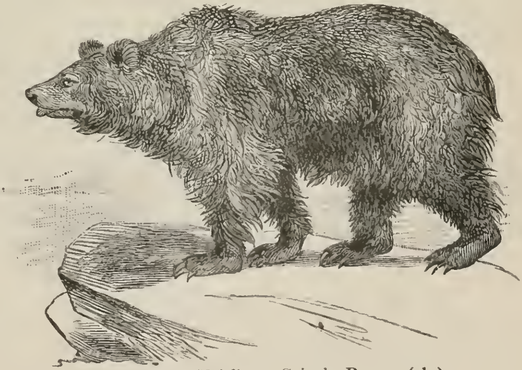
Fig. 427.



Ur' sus a mer i cā' nus. Black Bear.

colder latitudes it passes the winter usually in a hollow log, hibernating. It has a habit of sucking its paws even in the summer for hours at a time, with a peculiar grunting noise.

Fig. 428.

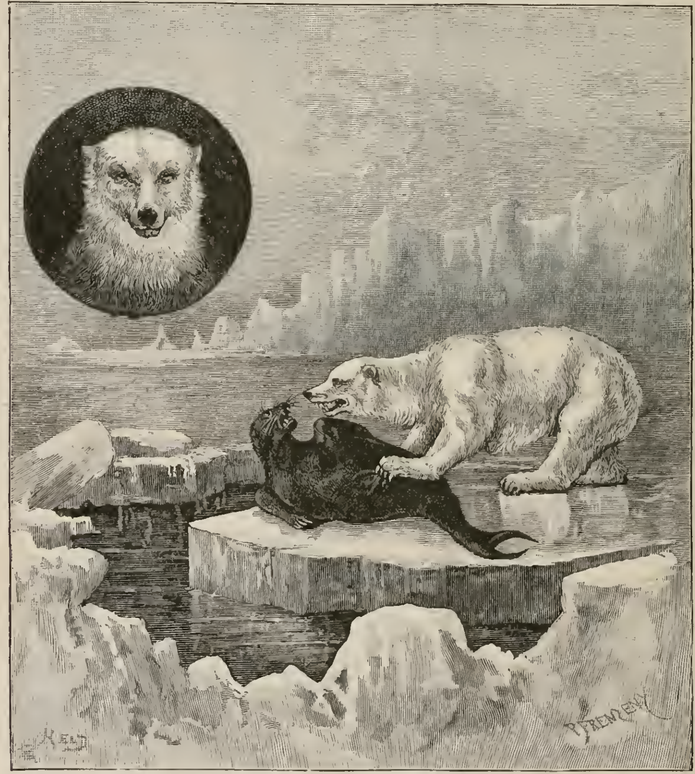


Ur' sus hor rĭb' i lis. Grizzly Bear. ($\frac{1}{30}$.)

The *Grizzly Bear*, so called because of the intermixture in its fur of grayish hairs with black and brown, is the most ferocious of the North American carnivora.

Its sharp, powerful claws, often five inches long, move independently of one another, and, when the animal strikes with its paws, cut like so many chisels. Its strength enables it to drag off a bison; and when acting on the defense is considered the most formidable animal of the New World.

Fig. 429.



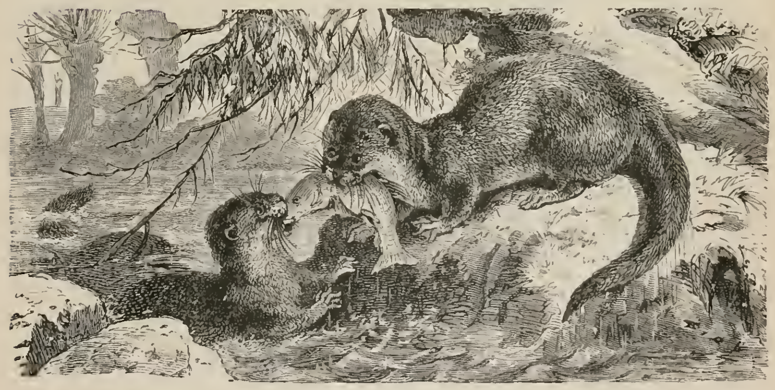
Ur' sus mar i tī' mus. White Bear.

The *Polar Bear* is the largest member of its family. It feeds on seals, fish, and walruses, which it pursues in the water, swimming and diving with great skill. To secure a firm footing on the ice, the soles of the feet are thickly covered with long hairs. It passes the winter months without hibernating.

The *Weasels* are greatly diversified in size, habits, color, etc. The more typical have fine fur, short legs, and slim, flexible bodies, which enable them to pursue their prey through small openings. Nearly all have glands secreting a disagreeable odor. Differences in dentition and manner of walking afford a means of tabulation.

AQUATIC.		Teeth = 36.	*Otter.*
TERRESTRIAL.	Semi-digitigrade.	Teeth = 31.	*Skunk.*
		Teeth = 31.	*Badger.*
		Teeth = 38.	*Wolverine.*
		Teeth = 31.	*Mink.*
	Digitigrade	Teeth = 34.	*Weasel.*
		Teeth = 38.	*Fisher.*
		Teeth = 38.	*Sable.*

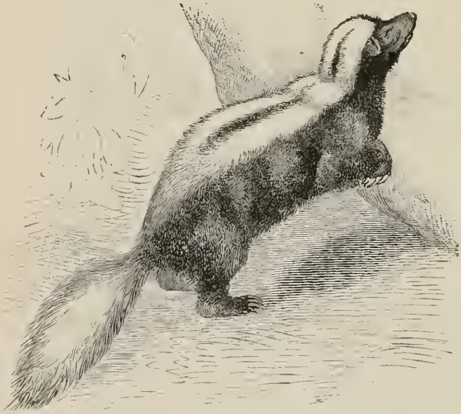
FIG. 430.



Lū' tra can a dĕn' sis. Otter. ($\frac{1}{18}$.)

The *River-otter* has but one species in North America, though it ranges from Hudson's Bay to the Gulf of Mexico. Its webbed feet exhibit an approach to the amphibious mammals. The peculiar position of its eye enables it, with a slight motion of the head, to see the fish on which it preys, whether swimming above, below, beside, behind, or before. It burrows in the banks of streams, forming an entrance under water, and providing numerous cells to occupy, according to the height of the stream. Its pastime of sliding in companies into the water, down a snow-bank in winter and a slippery clay-bank in summer, presents a singular feature of animal life.

FIG. 431.

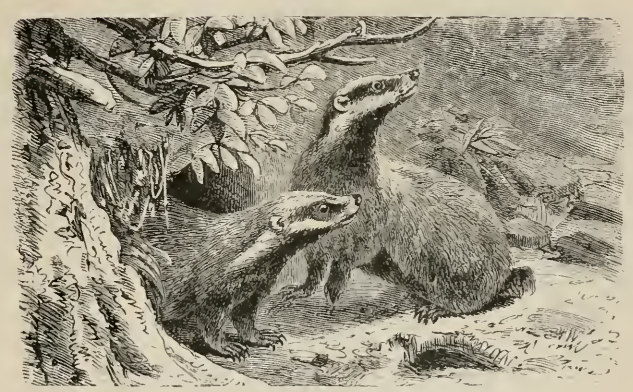


Me phī' tis me phĭt' ca. Skunk. (1/7.)

The *Skunk* is dark brown or black, and is ornamented above with one or two elongated patches of white, which may extend from head to tail; but individuals differ in their markings. When provoked, it emits an intolerable odor that few animals can endure. The fore feet are adapted for digging burrows, in which it hibernates without becoming torpid—entering its retreat in the fall, fat, and coming out in the spring, lean.

The *Badger*, inhabiting the western part of the United States, has long hair and a short tail. Its stout claws are well adapted for burrowing. Though so peaceable as to resign its nest without a struggle to those much weaker than itself, it can bite more fiercely than any animal of its size. Its skin is so loose and thick, that while the teeth of its assailants can make little impression upon it, the Badger can turn itself round in it, so as to reach and bite them. It feeds upon small animals, which it digs out of their burrows, leaving dangerous trap-holes for the unwary traveler.

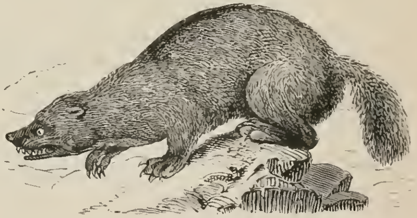
Fig. 432.



Tax ĭd′ ĕ a a mer ĭ cā′ na. Badger. ($\frac{1}{12}$.)

The *Wolverine* (wo͝ol′ vĕr ēn) inhabits the northern parts of Europe and America. Extravagant stories are told by trappers of its strength and ferocity,* whereas it is harmless to man, and only annoying by devouring animals caught in traps, and by destroying the hunter's hoards. With

Fig. 433.



Gū′ lo lŭs′ cus. Wolverine, or "Glutton." ($\frac{1}{15}$.)

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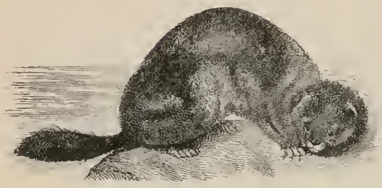
* Thus we are gravely informed that the Wolverine will drop from a tree upon the back of an animal passing underneath, and, clinging to its neck with long trenchant claws, tear open the blood-vessels until the poor victim falls lifeless.

a sagacity rarely permitting it to be ensnared, it skillfully tears the trap to pieces, and carries off the bait.

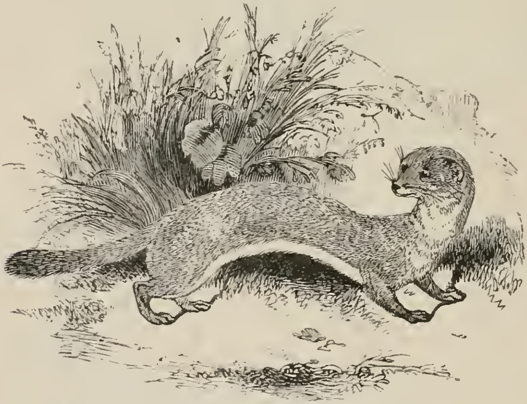
Fig. 434.



Pu tō′ rĭ us lu trē′ ŏ lus. Mink. ($\frac{1}{18}$.)

The *Mink* is brown, with a white spot under the chin. It is semi-digitigrade and semi-palmate (webbed), being thus fitted for hunting in the streams for fish, frogs, etc.

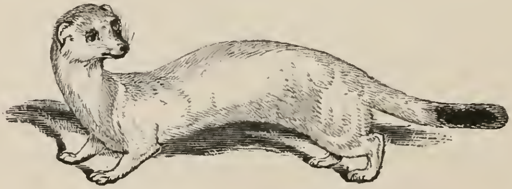
Fig. 435.



Pu tō′ rĭ us er mĭn′ ĕ us. Weasel in summer. ($\frac{1}{5}$.)

The *Weasel*, at the north, during summer, is reddish-brown above and white beneath. It changes from brown

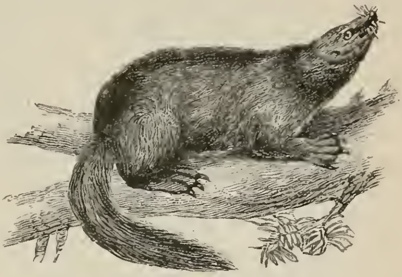
Fig. 436.



Pu tō′ ri us er mĭn′ ĕ us. Weasel in winter. ($\frac{1}{5}$.)

to white in October and November, and back again in March, except the extremity of the tail, which is always black. At the south, the same species does not vary its fur. These alterations are effected, not by shedding the coat, but by changes in the color of the hair. Weasels destroy mice, and hence are beneficial to farmers.*

FIG. 437.



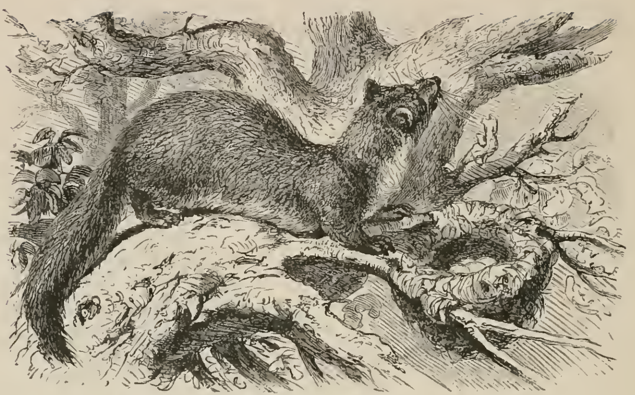
Mus tē′ la pen năn′ tĭ i. Fisher. ($\frac{1}{16}$.)

The *Fisher* and the *Sable* are native representatives of the genus *Mustela* (mŭs tē′lȧ). The former is the largest of the known species—its body sometimes measuring three feet in length. Though commonly called "the fisher," it has never been known to fish. "The stealer" would be a much more appropriate name, as it has been known to take the round of a hunter's traps during the night and steal the captured game. The native food of the Fisher consists of small mammals and berries, particularly berries of the mountain-ash. Once ranging throughout New England, and south to Virginia, its present limit in the United States east of the Mississippi River is mostly confined to the northern regions of New England and New York.

---

* Their carnivorous propensities are, however, not unfrequently displayed in the hen-roost. An Ermine has been known to kill forty full-grown fowls in a single night, as it devours the brain and sucks the blood, but never eats the flesh of an animal. Its mode of attack is to pounce upon its prey transversely, and piercing the brain at a single bite, to throw itself lengthwise upon the body, to which it clings until the death of its victim. Its ability to bend the head at right angles with the neck facilitates this mode of attack.—Ermine skins have long been used in England to decorate the robes of judicial officers, and hence their association with ideas of moral purity.—The expression "catch a weasel asleep" is based upon the ease with which the animal may be caught when sleeping, on account of the soundness of its slumbers.

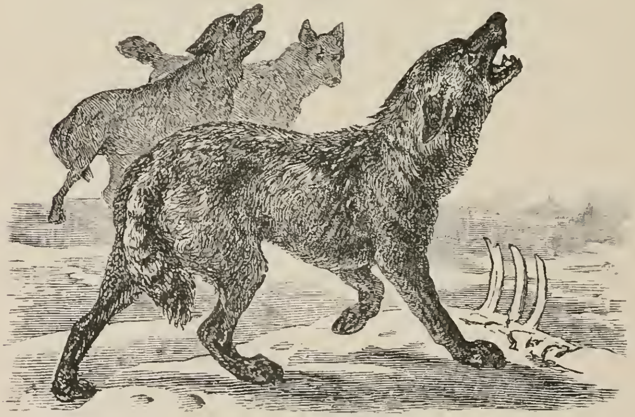
FIG. 438.



Mus tē′ la a mer i cā′ na. Marten, or Sable. ($\frac{1}{9}$.)

The *Sable* is arboreal, climbing with ease to the highest branches, in pursuit of birds and eggs. Its fur will lie smoothly in any direction.

FIG. 439.

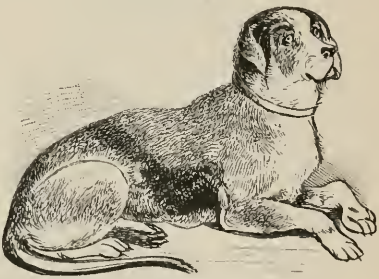


Cā′ nis lū′ pus. Wolf. ($\frac{1}{18}$.)

The *Dogs* have blunt toes, five in front and four behind, only moderately developed. The Dog never perspires through the skin, even in the hottest weather. It drinks by lapping, and so avoids the danger of swallowing large quantities of cold water when the body is overheated.

The *Wolf*, of which there is now considered to be but one species in North America, is the best representative of the Dogs. It generally hunts in packs. Unless impelled by hunger,* they seldom attack prey larger than themselves, and they are so wary of traps that a traveler when pursued, has frightened them away by merely trailing a cord. Their bite, unlike that of any other animal, is a succession of quick, violent snaps.

FIG. 440.



Cā′ nis fa mil i ā′ ris. **Mastiff.**

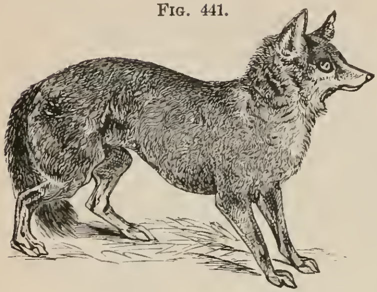
Of all the conquests achieved by man over animals, that of the Dog is the most complete, and, perhaps, the most useful. Not only is he the sole mammal that has followed man to the ends of the earth, but more than any other is he capable of education and disinterested affection. His habit of repeatedly turning round before lying down, is regarded as a singular retention of his mode in the wild state † of making a lair in the tall grass. The Dog attains maturity in two years, and lives from fifteen to twenty.

---

* Such is then their rapacity that they will make a meal of a harness, or even of old shoes that may be within their reach.

† The canine (*kă nīn′*) race, like the human, inherently adapted to variation and development, through the influence of climate and condition, presents innumerable varieties; though all are considered by most naturalists as having a common origin and to be regarded of one species. Many have supposed the wolf to be the progenitor of the dog. But, while the osteological structure of the two is identical, the total want of similarity in disposition, especially in affection for man, their hostility to each other, and their permanent physical differences—as the obliquity of the wolf's eye, and its drooping tail—oppose this theory. Besides, it is as reasonable to presume that the wolf descended from the dog, as the dog from the wolf. But no wild dogs—as, for instance, those of the Antilles, known to have sprung from domestic varieties—have ever approximated the character-

FIG. 441.

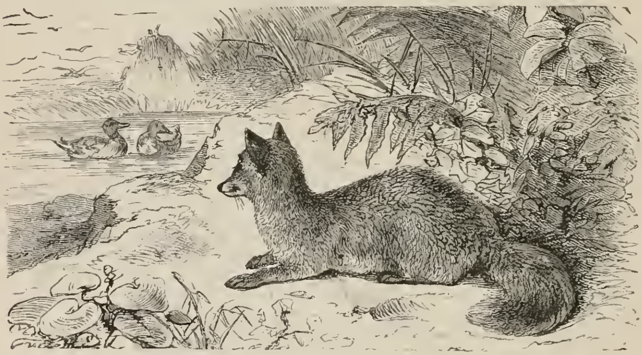


Că'nis au'rĕ us. Jackal. ($\frac{1}{12}$.)

The *Jackal* derives its specific name from the golden tint of its pelt. Like the Wolf, it hunts in bands; but it associates more intimately with man, acting the scavenger in consuming the street offal in the filthy towns of Eastern Europe and Western Asia.*

The *Fox* is mostly nocturnal, springing upon its prey as it passes by, or stealing upon it while asleep. Its dentition is calculated for a mixed diet, so that mammals, birds, mollusks, and even grapes, furnish a dainty

FIG. 442.



Vŭl' pes vul gā' ris. Fox. ($\frac{1}{12}$.)

---

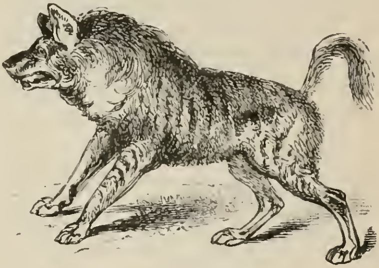
istics of Wolves. Hence, with Pritchard, we conclude, "As with the race of man, so with the race of dogs, the varieties have become permanent from one original pair." It is, however, a mooted question.

* In uninhabited regions, it often feeds upon the remnants of carcasses left by lions, and hence the absurd idea that it is the companion of that beast, and runs down his prey for him.

meal. Its characteristic is craftiness.* Its maternal instinct is also highly developed, and it will peril its life to save its young. Several species are often found inhabiting the same locality.

The *Hyenas* are peculiar to the warmer regions of the Old World. The enormous strength of their jaws and the size of their blunt molar teeth, enable them to crush the largest bones, which they swallow without mastication. In adult animals, the vertebræ of the neck often grow together, enabling them to endure a violent strain. The toes are four, with blunt, non-retractile claws. The bending of the hind legs makes them seem shorter than the fore legs and gives an awkward shuffle to the pace. The Hyena is the true scavenger among the mammals, removing offal which would endanger the health of man.

Fig. 443.



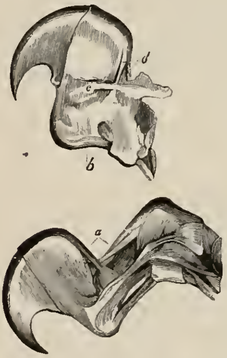
Hy ē′ na vul gā′ ris. Hyena. ($\frac{1}{38}$.)

The *Cats*, typical of this order, are all *digitigrade* (dĭ′gĭt ĭ grade) [toe-walkers]. Lest their claws should be blunted by coming in contact with the ground or impede their progress by getting entangled in the grass, they are *retractile*, *i. e.*, the upper tendons of the toes hold them back without any exertion of the will. Resting upon its soft, padded feet, and with its claws sheathed, the animal steals noiselessly toward its prey. As the fatal spring is made, the lower muscles suddenly contract, and, drawing the claws forward, bury their sharp points in the victim's flesh. The tongue is covered with innumerable little hooks pointing backward.

---

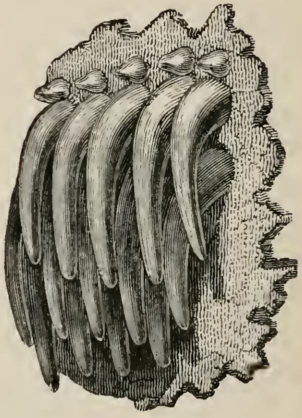
* A hunted fox will run a long way in a straight line, then doubling on its track, suddenly spring off to a great distance one side and quietly steal away, while the hounds are eagerly following up the scent; it will leap from tree to tree, and hide in some convenient hollow; it will perfume itself with any odorous substance it may meet, in order to deceive the dogs; it will run at full jump to the crest of a hill, then quickly lie down, while the headlong speed of its pursuers carries them pell-mell to the bottom; and even if caught it will feign death, permitting itself to be handled, kicked about and carried away, without showing any sign of life until a chance of escape offers, when it will suddenly dash off, to the intense surprise of those whom it has so cleverly duped.

FIG. 444.



1, Claws Sheathed.
2, Claws Extended.

FIG. 445.



Tongue of a Carnivorous Animal.
(Highly magnified.)

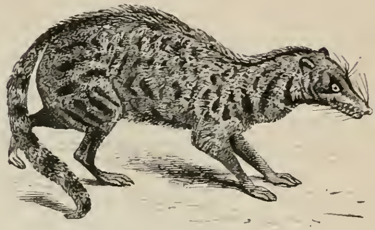
These are for rasping the bones which it gnaws for food, and beautifully illustrate the economy of Nature, which allows no waste. The whiskers on the upper lip are of great service to the animal while skulking about in the darkness, seeking its food. They equal the body in width, and by indicating the breadth of any opening, warn it from attempting too close a bush, and thus causing a rustle which might alarm its prey.

The *Civet* (sĭv′ĕt) has semi-retractile claws. It is also characterized by a double pouch, secreting a fatty substance used as a perfume; and by the pupil of the eyes being circular during the day instead of vertical, as in the Cats.

The *Genet* (jē nĕt′) has retractile claws. It wages war on rats and mice, and in many parts of the East is domesticated.

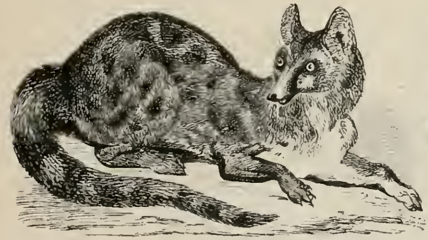
The *Ichneumon* (ik nū′-mȯn) is semi-plantigrade, and has the pupils elongated transversely. It preys on the eggs and young of the crocodile and various reptiles, and is often domesticated.

FIG. 446.



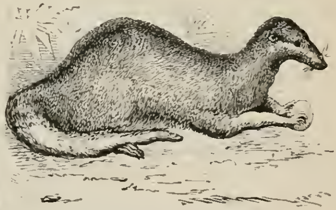
Vi vĕr′ ra ci vĕt′ ta. Civet. ($\frac{1}{12}$.)

FIG. 447.



Gen ĕt′ ta vul gā′ ris. Genet. ($\frac{1}{10}$.)

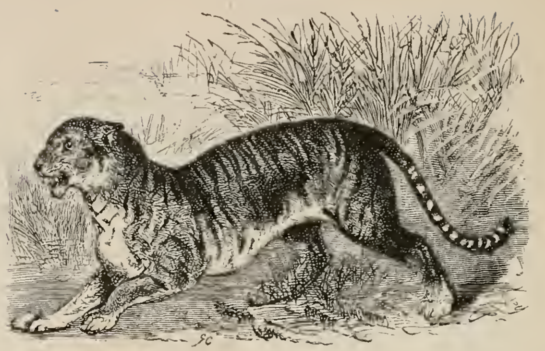
FIG. 448.



Her pĕs′ tes ich neu′ mon. Pharaoh's Rat. ($\frac{1}{13}$.)

The *Tiger*, being destitute of a mane and tail-tuft lacks the noble bearing of the lion, but is beautifully decorated with black stripes upon a ground of reddish-yellow fur, tending to white beneath. Its ferocity, especially that of the dreaded "man-eater," is fearful, while its strength enables it to carry off a buffalo thrown over its shoulder. Inhabiting Southern Asia, its home is in the long jungle-grass, with the coloring of which its stripes so exactly assimilate that it is impossible for unpracticed eyes to discern it at even a short distance. This adaptation of the color of an animal to that of

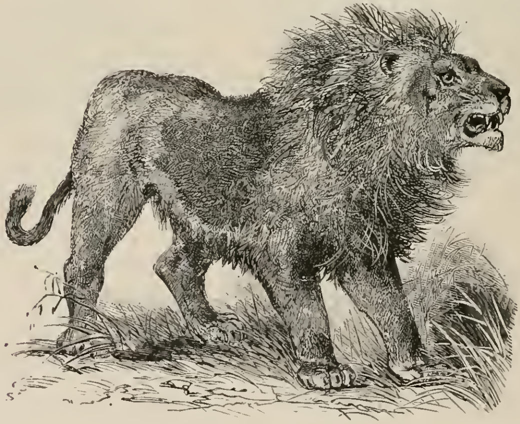
Fig. 449.



Fē′lis tī′gris. Tiger. ($\frac{1}{50}$.)

surrounding objects in its native wilds is termed *mimicry*, and is one of the most wonderful provisions of Nature.

Fig. 450.



Fē′lis lē′ō. Lion. ($\frac{1}{40}$.)

The *Lion** is known as the "King of Beasts," more from his majestic appearance than any nobleness of disposition.* The tail is tufted, while the neck of the male is ornamented with a flowing mane that in some varieties reaches nearly to the ground.† His tawny, uniform color, closely corresponding to that of the desert tracts in which he lives, aids his concealment in stealing upon his prey. The pupil of his eye is round, giving as extensive horizontal vision as vertical; and his strength is such that he can carry off a cow with ease, even leaping broad dikes and keeping ahead of pursuing horsemen for miles without dropping it. He naturally feeds at night, so that his apparent magnanimity in sometimes sparing man and beast during the day is only because he is already satiated with food. Like many other animals, he has no desire to kill merely for the sake of killing.

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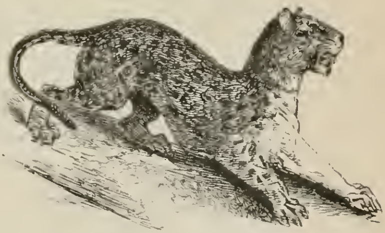
* Zoologists have described different species of the Lion, but they are now considered only geographical varieties distributed over Africa and southern Asia.

FIG. 451.



Fē'lis le o păr'dus. Leopard. ($\frac{1}{28}$.)

The *Leopard* (lĕp′ărd), now considered identical with the Panther, inhabits Africa, India, and the adjacent islands. Its mimicry is striking—its skin being marked with circles of dark spots, corresponding to the leaves of the tree among which it conceals itself. In Java there is a black variety lately discovered.

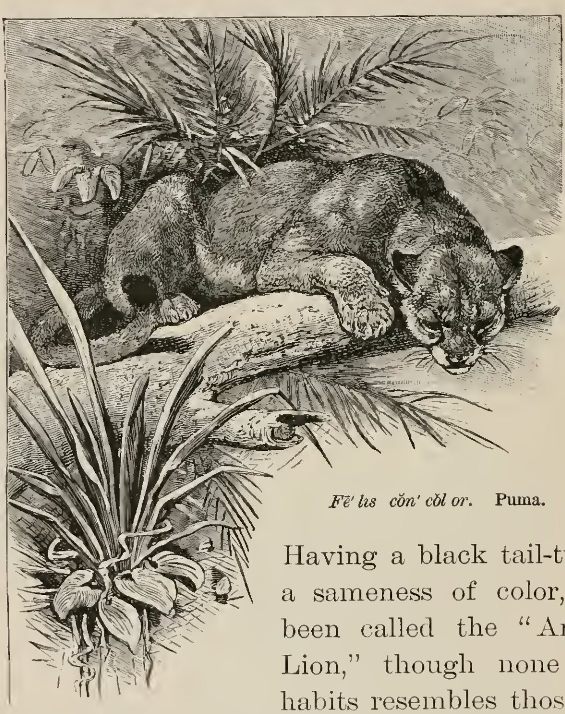
---

* Livingstone and Gerard pronounce him cruel and cowardly. He secures his prey by lying in ambush till it comes within reach of his terrible bound, and if the first spring fails, like the tiger, he sneaks back to his covert ashamed and disappointed. In fact, his speed is too slow to permit his overtaking his game.

† It is asserted by some travelers that the roar of the Lion is terrific beyond description, while others declare it to resemble the discordant cries of the ostrich. Probably the degree of fear aroused colors the narration. Since the Lion's larynx is relatively larger than that of any other mammal, there may be no exaggeration in the statement that its roar sometimes shakes the ground like an earthquake, and carries dread to every animal within hearing.

The *Puma* (pū′mȧ)* inhabits North and South America. Its uniform dun color gives a mimicry for its protection while crouching upon the branches of trees.

FIG. 452.



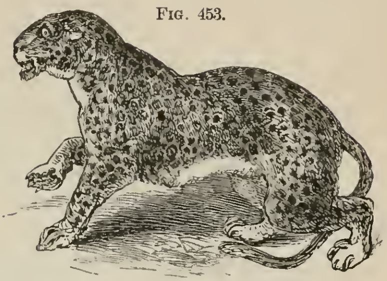
Fē′ lis cŏn′ cŏl or. Puma.

Having a black tail-tuft and a sameness of color, it has been called the "American Lion," though none of its habits resembles those of its African namesake, except perhaps its cowardice. Its range of habitat is more remarkable than that of any other of the Cats, though it has disappeared from all long-settled parts of the Continent, through the persistent efforts of man to exterminate it. A black variety of this species is also said to exist in South America.

---

* In different parts of the Continent the Puma is styled the "painter," the "panther," the "cougar" (*koo′ gär*), and even the "catamount," though there is no panther in America, and the true catamount is the wild cat of Europe.

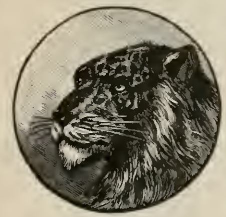
FIG. 453.



Fē' lis ŏn' ça. **Jaguar.** ($\frac{1}{23}$.)

The *Jaguar* (jăg ū är′), inhabiting the warmer parts of America, is the New World representative of the Leopard, though more powerful. The circles upon its sides have a black spot in the center, well calculated to deceive the eye as the animal glides through the dense foliage of the tropical forests in pursuit of monkeys, swims in the lagoons for turtles, or prowls around the herds of cattle for larger prey.

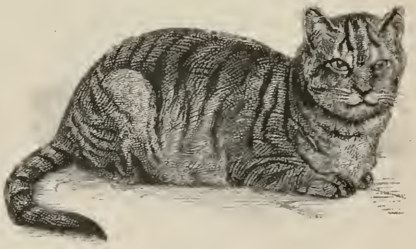
FIG. 454.



Head of Jaguar.

Domestic Cat.—No wild animal is known that can be the original of the Domestic Cat, though there are several which bear some resemblance to it. There is a marked difference in the length of the tail of the wild and the domestic species. Still greater variations are found in dogs of the same race.*

FIG. 455.



Fē' lis do mĕs' tĭ ca. Cat.

The *Canada Lynx* and the *Wild Cat* are by some considered only as geographical varieties, and claim that these, with a spotted variety inhabiting the southern portions of

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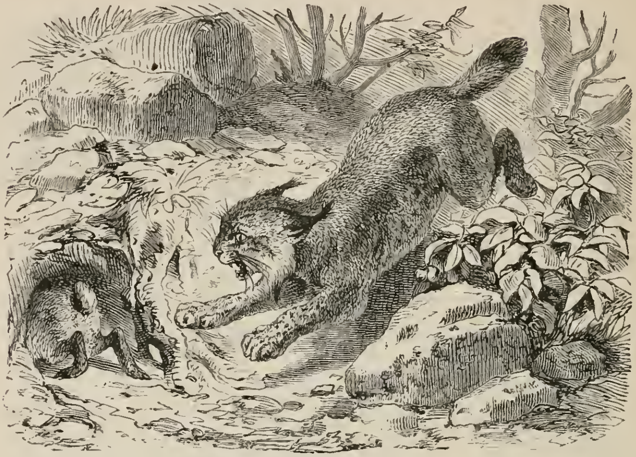
* Probably, animals designed by the Creator for domestication, have inherent tendencies to variation in form and color, according to climatic and alimentary influences, so that individuals may be more readily recognized. (See note, p. 253.)

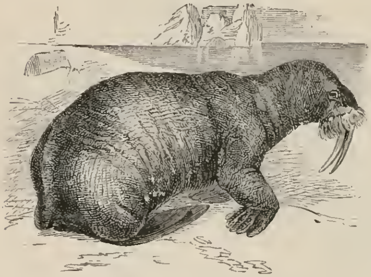
North America, should be included in one species known as *Felis borealis* (fē′lis bō rē ā′lis). They all live upon birds and small mammals, pursuing them among the branches of the trees as well as upon the ground. Their gait is by bounds, the animal landing upon all four feet at once.

Fig. 456.



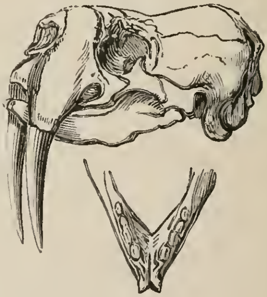
Lynx can a dĕn′ sis. Lynx. ($\frac{1}{26}$.)

Fig. 457.



O do bœ′ nus rŏs′ mă rus.
North Atlantic Walrus. ($\frac{1}{80}$.)

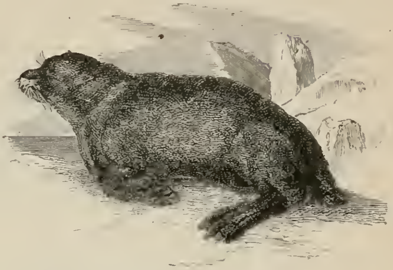
Fig. 458.



Canine Teeth and Under Jaw of Walrus.

The *Walrus* (wŏl′rŭs) has the canines of the upper jaw prolonged into two tusks, which project downward sometimes to a length of two feet. The roughened soles of its feet enable it to ascend icebergs to a great height. It feeds on mollusks which it digs from their beds, and also on sea-weed. The Walrus of the North Pacific differs so much from the Walrus of the North Atlantic as to be considered a different species under the name *Rosmarus obesus* (rŏs′mă rus o bē′sus).

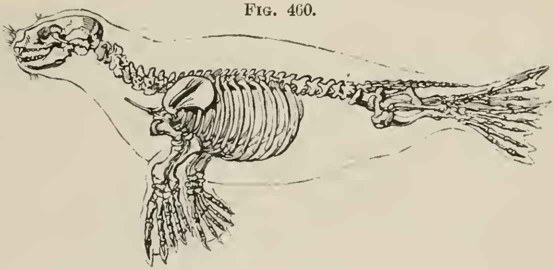
Fig. 459.



Cal lo rhī′ nus ur sĭ′ nus. Fur Seal. ($\frac{1}{32}$)

The *Eared Seals* are principally found in the Pacific Ocean. The most important species is the Northern Fur Seal,* which furnishes the rich seal skins of commerce. Though once distributed over the north-west coast of America, they are now restricted to a few small islands in the Aleutian Archipelago. Each mother, in returning from a fishing excursion, will pass by thou-

Fig. 460.



Skeleton of Seal.

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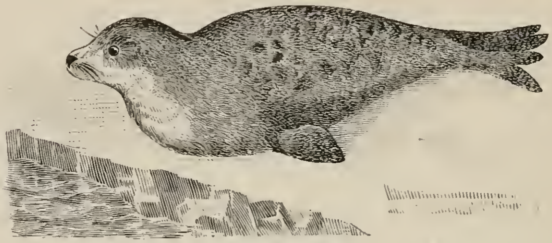
* The Sea Lion is a species of the Eared Seal. In the harbor of San Francisco hundreds of these animals are seen, scrambling over the steep rocks, biting and pushing off their comrades, and rolling over one another, keeping up, meanwhile, a peculiar and incessant barking.

sands of young lying along the shore and bleating like sheep, till it comes to its single cub.

The *Common Hair Seals* are not provided with external ears. They abound upon the Atlantic coast, the different species varying in length from three feet upward, and present great variety of color and marking. Their eyes are large, with an intelligent expression,* and the animal is easily tamed.†

FIG. 461.



Phō' ca vit u lī' na. Common Hair Seal.

ORDER QUADRUMANA (kwŏd rōō' mă nȧ).

The characteristics which separate the members of this order from those already treated are: the opposable position of the inner digits and thumbs of both hands and feet; the possession of flat nails in place of claws; the eye-sockets entirely surrounded by bone, and the cerebral hemispheres generally well developed. The representatives naturally fall into two divisions: the *Lemurs* (lē′mẽrz), restricted to the Old World, and the *Anthropoidea* (ăn thrō poid′ĕ ȧ) of both hemispheres. Though now only found in the Old World, Madagascar presenting the greatest variety of forms, geology has shown that the latter once inhabited America.

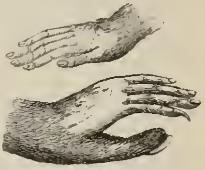
---

* Emerging unexpectedly from the depths of the sea, with dripping manes (which some species possess) and uttering a feminine scream, it is not strange that the imagination has mistaken them for human beings and given rise to the legends of tritons, sirens, sea-nymphs, and mermaids. The Hair Seals have the singular habit of swallowing stones, as many as four pounds of sharp pebbles having been found in a single stomach, but no satisfactory explanation of this phenomenon has been given.

† The Walrus and the Seal furnish food, light, fuel, clothes, thongs, boats, and hunting implements, to the inhabitants of the Arctic regions. Some Naturalists separate the Walrus and Seal from the Carnivora, and class them in a distinct order, called *Pinnipedia.*

The *Lemurs** present many points of structure which might unite them with lower forms were it not that their more important peculiarities are distinctly ape-like. The muzzle is sharp and fox-like; the feet are prehensile; the first digit is of large size; and the second toe may be armed with a long claw; but the other digits, including those of the hands, are generally terminated with nails.

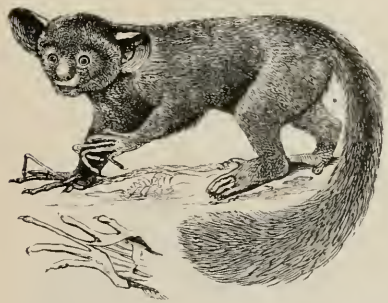
Fig. 462.



Foot and Hand of Lemur.

The *Aye-aye* (ī ī)† inhabits Madagascar, where it has so long been protected by the natives, who regard it with superstition, that it has lost all fear of man. With its large ears and acute sense of hearing it discovers the whereabouts of boring insects; with its sharp teeth it pulls away the bark, and then with its *greatly elongated and*

Fig. 463.



Chei′rŏ mys mad a gas ca ri en′sis. Aye-aye.

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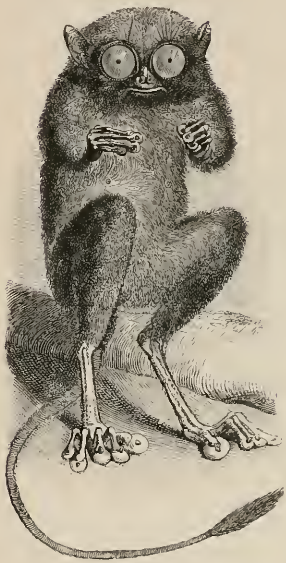
* Lemur means spectre, and is descriptive of the nocturnal habits and stealthy step of the animal. In fact, it is known among sailors as the "Madagascar Cat."

† It is an illustration of what is known as a comprehensive type, since it possesses peculiarities which link it to different orders—the Quadrumana and the Rodents.

slender finger it withdraws the larva from its hole and quickly devours it.

FIG. 464.

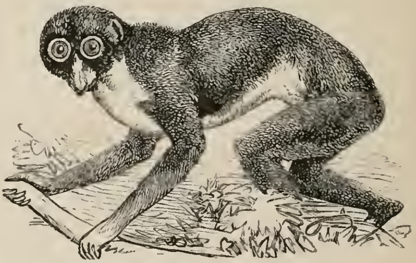


Tar′sĭ us spĕc′trum. Specter.

The Specter, confined to a small portion of the East Indies, is also of nocturnal habits. This animal has the hind legs formed for leaping, like those of the tree frog—a resemblance intensified by the presence of a large sucker attached to the end of each toe. The teeth, which resemble those of some of the moles, show the animal to be insectivorous.

The *Graceful Loris* inhabits Ceylon, Java, etc. Prowling in the darkness, it would be quite invisible, were it not for its round, shiny eyes. Espying a sleeping bird among the branches, it creeps toward it with noiseless, imperceptible movements, until it can place its fingers over its prey, when, with a motion quick as a flash, it seizes it. Its diet is also vegetarian, especially in its fondness for fruit. Attached to a branch, and rolling its body up into a ball, with the head hidden among the legs, it generally spends the day sleeping.

FIG. 465.

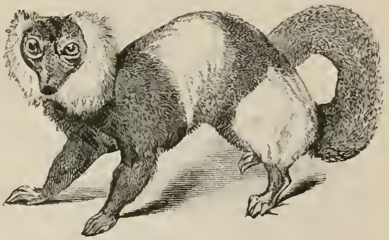


Lō′ris grac′ĭ lis. Graceful Loris.

The *Ruffled Lemur*, inhabiting Madagascar, is large and handsome. Wrapped up in its long, bushy tail, it passes the day in sleep, and only comes forth at night to search for food, when it is very noisy. The male is of a deep black color, though the female may be marked with white.

The second division, *Anthropoidea*, includes the higher quadrumana—those which have the cerebral hemispheres extending posteriorly to a greater or less extent, and the eye-sockets surrounded with a complete ring of bone.

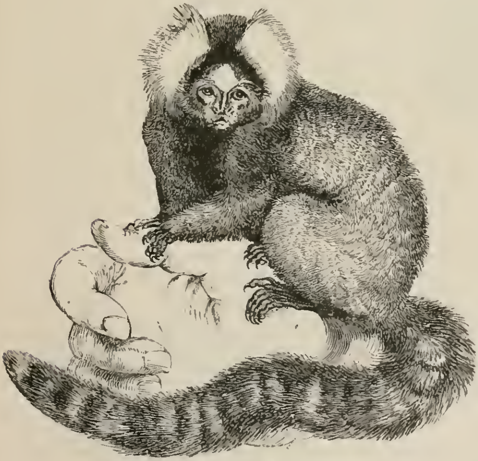
FIG. 466.



Lē mur ma cī co. Ruffled Lemur.

The *Marmoset* (mär′mō zĕt)* has not the power of freely moving its thumb; and as the other digits, with the exception of the first toe, are terminated with claws, its mode of progression is much like that of the squirrels. Its food is not grasped by the fingers, but held between the fore paws. Several species are recognized by Naturalists, all inhabiting South America.

FIG. 467.



Hăp′ ă le jăc′ chus. Marmoset. (⅓.)

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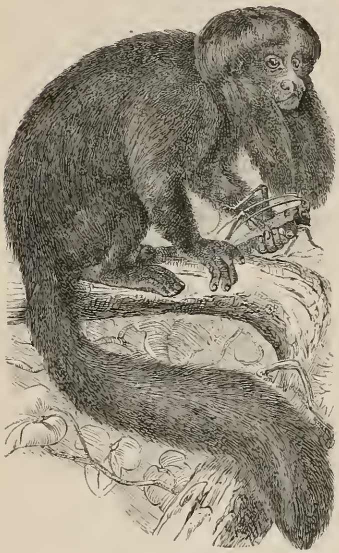
* This little creature is only six or eight inches in length, and a century ago was held in great estimation as a pet by ladies of quality. So great is its fondness for insects, that it has been known to tear out their pictures from a book.

The remaining Monkeys of the New World are quite different from the Old World forms. The nostrils are separated by a broad septum, and the teeth number thirty-six. The tail is often prehensile, and the thumb, which is sometimes wanting, never has the freedom of movement which is characteristic of the first toe.

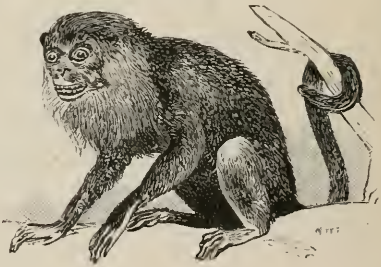
The *Pithecia satanas* (pithē′ sĭ ȧ sa′tăn as) is remarkable in that its head is covered by long black hair, which has a distinct parting along the crown. In addition to this, the sides of the face and chin support a large growth of long hair, resembling whiskers. Though having good vocal organs, their cries are not to be compared with those of the following genus.

Fig. 468.



Pi thē′cĭ a sa′tăn as.

Fig. 469.

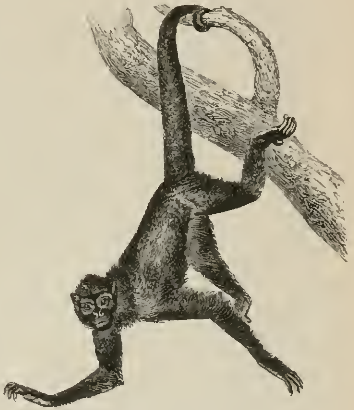


My cē′tes ur sī′nus. **Bear Howler** ($\frac{1}{18}$.)

The *Howling Monkey*, by a special hyoidean apparatus, is given the power of producing a call exceeded in its depth and dismalness by no other animal. Besides this accomplishment, it uses its long tail as a fifth hand, the muscles being so strong that they can easily hold the pendant body, and may even remain contracted after death. Large numbers of this species are captured by the natives of South America and used for food.

The *Cebus* (sē′ bŭs) *Monkeys* are those most often met with in menageries and seen with organ-grinders. Many of them are of a most affectionate but jealous disposition. Closely related are the *Spider Monkeys*, which have the thumbs rudimentary or absent. They receive their name from their long slender limbs. They abound in the tropical forests, seldom leaving the trees, where they gambol among the branches with the greatest agility. Individuals have been observed to jump from a tall tree down to a lower one fifty feet distant.* Their tails are not only used to assist them in climbing, but, not unfrequently, to carry their food to their mouths.

FIG. 470.



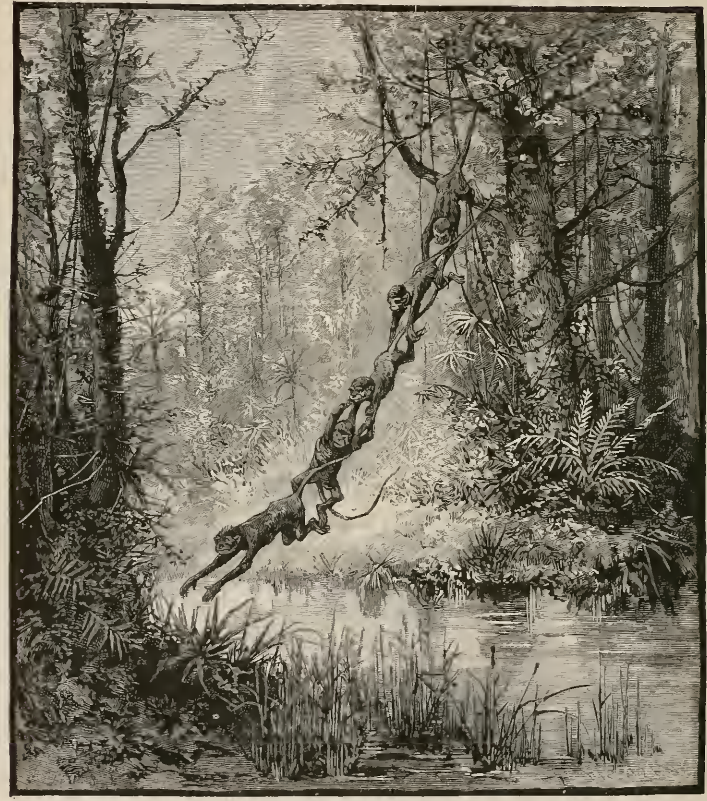
At′ ĕ les . pen ta dăc′ tў lus.
Spider Monkey. ($\frac{1}{13}$.)

The Old World Monkeys have the nostrils but little separated from each other, the teeth, thirty-two in number, and the tail, which is never prehensile, extremely variable even in a single genus. Though the thumb may be absent, when present, it is opposable to the fingers, having free movement, and the digits are always armed with nails, never with claws. Cheek-pouches, opening into the mouth, are present in many of the forms, though not characteristic of the group. The brain is generally well developed, and the animals are more intelligent than their New World relatives.

---

* When these animals wish to cross a river, the strongest ascend a high tree overlooking the stream. The leader securing his tail firmly to a limb drops downward, while the next attaches himself to his predecessor, and so on, forming at last a long chain of monkeys. This swings to and fro until the end monkey grasps a limb upon the opposite bank. Along this living suspension bridge

FIG. 471.

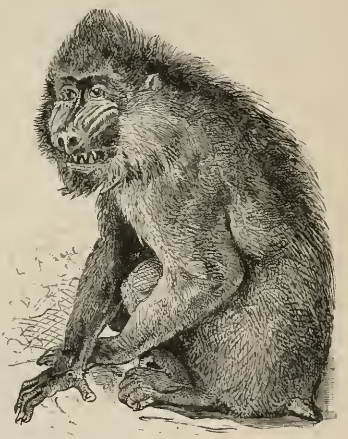


Group of Monkeys.

the troop pass over, a mischievous monkey occasionally playing off a practical joke on some member as he hurries forward. To get the bridge across, the first monkey lets go and the chain swings over, perhaps ducking one or two, when all unfasten and catching at the branches, proceed on their journey.

The *Baboon* (băb ōōn′) of Africa, with its dog-like muzzle, is the ugliest and most ferocious of the Monkeys. It dwells among craggy rocks, which it climbs with great agility, and fragments of which it will throw at those who attack its strongholds. Its food consists of bulbous roots, eggs, insects,* etc.

FIG. 472.



Cyn o cĕph′ ă lus mŏr′ mon.
Mandrill. ($\frac{1}{20}$.)

The *Mandrill* (măn′drĭl) is conspicuous for its variety of color—its nose being red, with a bright scarlet tip; its cheeks, a brilliant blue; its beard, a citron-yellow; and its body, a grayish brown, tinged above with olive. Its tail is much shorter than the Baboon's, measuring little over an inch in length. It inhabits the west coast of Africa.

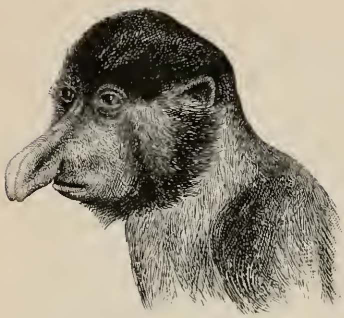
The *Macaques* (mă käk′) abound in the Malay Archipelago, Northern Africa, and Southern Asia, where they often raid plantations, doing great damage, though the superstitious natives seldom punish them. Representatives of this group are to be seen in every menagerie—the *Rhesus* (rē′sŭs) Monkey being most common. The *Barbary Ape*, of which a small colony has lived for centuries on the rocks of Gibraltar, is a related form, and is the only European Monkey, though indigenous to the north of Africa. Inhabiting the precipitous sides of the Rock, it enjoys an exemption not accorded elsewhere to its race.

---

* It devours scorpions with great dexcrity, whipping off their stings so quickly as to give them no chance to strike it.

The *Proboscis Monkey* of Borneo has a flabby nose, six inches long, the tip coming quite below the lowest point of the chin.

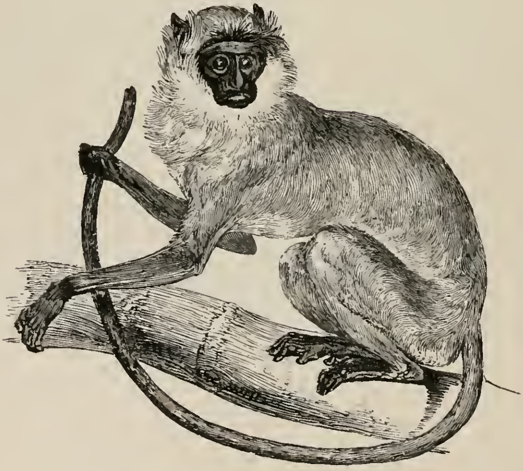
FIG. 473.



Sem no pĭth ē' cus na sī' ca.
Proboscis Monkey. After Hornaday.

The *Sacred Monkey* receives divine honors from the natives of India, who believe it a metamorphosed prince, and punish its slaughter by death, although a trifling fine compounds for the murder of a man.* It is permitted to ravage their gardens at will—it being considered a great honor to be robbed by it—even hospitals being erected for its reception, when sick or injured.

FIG. 474.



Sem no pĭth ē' cus en tĕl' lus. Sacred Monkey. ($\frac{1}{10}$.)

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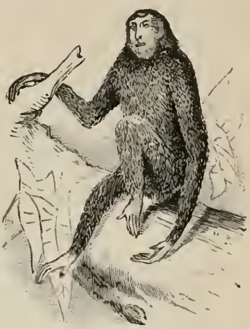
* It may have become interwoven so remarkably with the superstition of the Hindoos on account of being an expert serpent-killer.

We now come to the *Apes*—Monkeys of considerable size, having no external evidence of a tail, without cheek-pouches, and with elongated fore limbs. When standing upright, an unnatural position, they rest on the outer edge of their feet, since they are not able to place their soles flat upon the ground.

The *Sumatran Siamang* (sī′ ă măng) derives its specific name from the adhesion of the second and third toes as far as the joint that bears the nail. It has a vocal organ resembling that of the Howling Monkey.

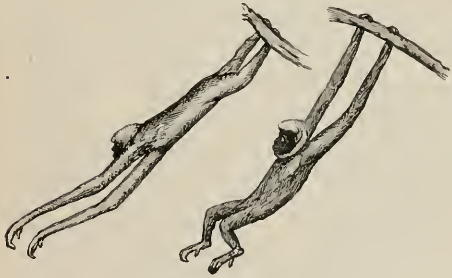
Fig. 475.



Hy lŏb′ ă tes syn dăc′ tÿ lus. Siamang.

The *Gibbons* of Southern Africa and Malay Archipelago are distinguished by the length of their arms and the slenderness of their form. With a height of three feet, the reach of the extended arms is six feet, enabling it to swing through the air among branches twenty feet apart.

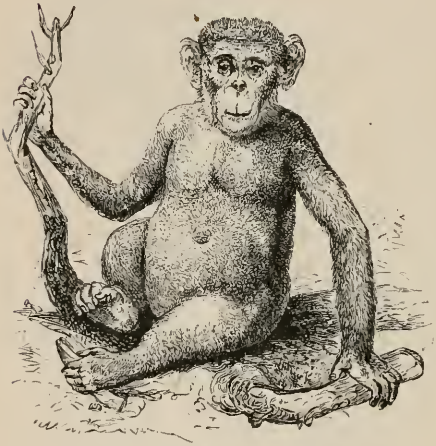
Fig. 476.



Hy lŏb′ ă tes ag′ ĭ lis. Gibbon. After Hornaday.

The *Orang* (ō răng′) is also adapted to an arboreal life. It inhabits the islands of Borneo and Sumatra. In the wild state it is frugivorous (fruit-feeding), not even eating eggs, though the teeth are adapted to either vegetable or animal food. Matured Orangs reach a height of four feet, their long arms enabling them to span seven feet. At night they rest, stretched at full length, upon a bed of branches which they have broken off or bent down and placed conveniently for a support to their bodies, each hand grasping a limb which it clutches mechanically.

FIG. 477.



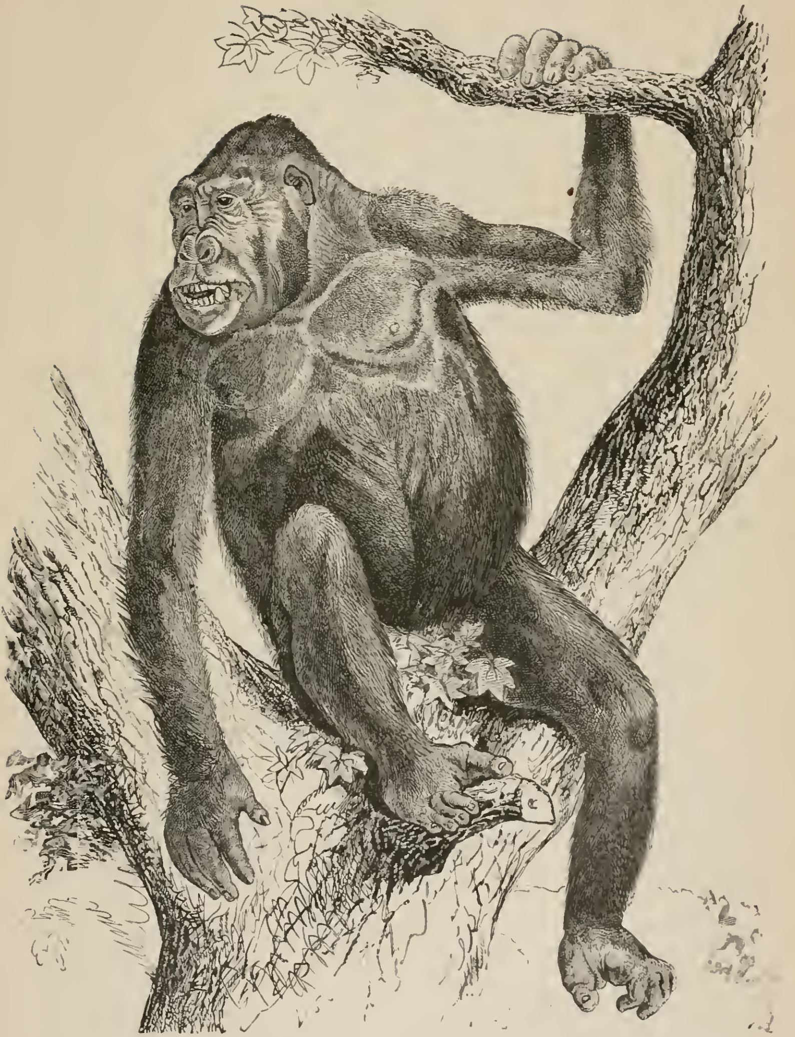
Trog lo dȳ′ tēs nī′ ger. Chimpanzee.

The *Chimpanzee* (chĭm păn′zē) is widely distributed over tropical Africa, where it feeds on fruits, being an arboreal animal. Like the Orang, it is known at times to construct in the tree-tops platforms of bushes, on which the female may rest and care for her offspring. Naturally of a timid disposition, it will bravely defend itself when attacked. Full-grown individuals measure five feet in height. They are the most common anthropoid apes of zoological gardens.

Somewhat exceeding the Chimpanzee in size and of a much more ferocious appearance, is the *Gorilla* (gō rĭl′lȧ), the highest known animal excepting man. The Gorilla has arms relatively shorter than the immediately previous forms, the legs and feet are better adapted for walking, and the three middle fingers of the hand are united, leaving but two joints free, while the thumbs are short and rudimentary It agrees with the previous species in having thirteen pairs of ribs, the Orang only having twelve.

In its habits the Gorilla generally lives singly or in pairs, feeds on various plants and fruits, and sometimes

FIG. 478.



Trog lo dȳ' tēs go rĭl' la. Gorilla. ($\frac{1}{12}$.)

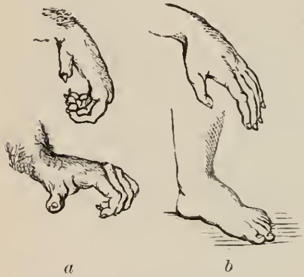
raids plantations. It is seldom domesticated, even for menagerie exhibitions.

ORDER BIMANA (bī mā′nȧ).

This order comprises only one genus and a single species; thus,

ORDER.	GENUS.	SPECIES.	EXAMPLE.
BIMANA.	Homo,	sapiens.	*Man.*

Fig. 479.

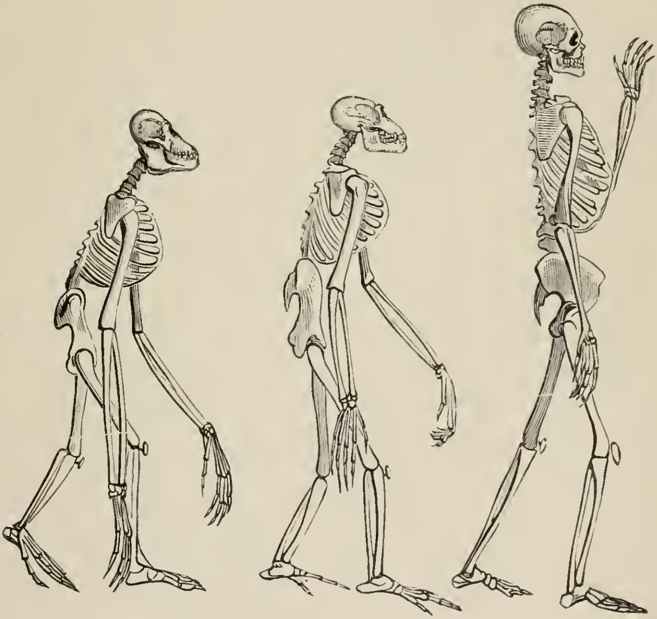


a, Monkey's Hand and Foot.
b, Human Hand and Foot.

Man—the lord of the Animal Kingdom—is constructed after the same type as the cat that purs at his feet, the ox that he eats, the horse that bears his burden, the bird that sings in his gilded cage, the snake that crawls hissing across his pathway, the toad that hides in his garden, and the fish that swims in his aquarium. All are modifications of one creative thought, showing how the Almighty Worker delights in repeating the same chord, with infinite variations. There are marked physical peculiarities, however, which distinguish man from the other mammals. Thus, the position of the spinal opening in the middle third of the base of the skull, thereby balancing the head and admitting an upright posture; the sigmoid S-curve of the vertebral column; the ability of opposing the well-developed thumb to the fingers; the shortened foot, the sole resting flat on the ground; the size and position of the great toe; the length of the arms, reaching half-way from the hip to the knees; the relatively great development of brain; the freedom of the anterior extremities from use in locomotion, and the consequent erect and biped position. In addition, man is the only mammal that truly walks; that is endowed with the power of speech; and that is cosmopolitan, readily adapting himself to extremes of heat and cold, and making his home in all parts of the globe. (See Fig. 480.)

There are intellectual and moral features, moreover, which place man high above all other animals. The scope of his mind and the possibilities of an immortal soul, mark the rank of a being who is alone declared to have been created "in the image of God."

FIG. 480.



Skeletons of Orang, Chimpanzee, and Man.

Common Origin of Man.—While in the human race there is but a single species, zoologists are accustomed to speak of several very distinctly-marked varieties. In respect to the dividing lines of the commonly-enumerated five races, authors disagree. So that, although there are some differences of structure and great diversity in the texture of the skin and the character of the hair of mankind in various localities, yet in the same nation there are similar varieties; and as marked diversities have repeatedly been observed in a single species of the domestic animals. We therefore agree with Dr. Prichard "that no other differences occur than may fairly be attributed to the differences of external circumstances; and hence it may safely be concluded that the different races are all members of the same family, and the offspring of one common stock."

III. APPENDIX.

MIGRATIONS OF BIRDS.

Many species of birds leave certain localities in the fall, and, spending the winter at the South, return in the spring. Why they do thus has never been satisfactorily explained. The failure of food in rigorous climates is, without doubt, the main factor in the solution of the problem, but it is by no means the only one. Birds might incubate in warm latitudes as well as in cold; unless, perhaps, a second factor be found in the physical necessity of maintaining a uniform temperature. But individuals of many migratory species remain in the region of their nativity with no apparent inconvenience. Greater freedom from molestation in rearing their broods has been suggested as a third factor. If it be so, then all southern birds should come north. Some birds return, year after year, to the same localities, as proved by tying bits of red silk to their legs; but it can not be positively asserted of many species. The southernmost limits of some individuals of a species may also be the northernmost limits of others, so that the species may be regarded as resident, though the individuals are migratory.

The males of some of the Thrush family, as well as those of certain species of other families, in migrating northward precede the females by two or three weeks, while the sexes associate in going southward.

It is not determined whether any of the northern birds migrate as far as the Equator, though many individuals of most of the species are known not to pass beyond the Gulf States, especially the southern half of Florida. The strictly insectivorous birds, as swallows, martins, etc., collect in flocks and leave earliest in the fall. They are followed by the granivorous when seeds become scarce or covered with snow.

Extensive districts become gradually depopulated of certain species, while in other regions they multiply. After a time the former localities are revisited by the species that had become nearly or quite extinct, while the latter lose their abundance. Hence, to the annual migrations must be added others marked by cycles of years; and not necessarily in lines of longitude, but as frequently in those of latitude.

Birds come and go; but whence they come and whither they go is a matter of conjecture. One morning the trees of Independence Square, in the heart of Philadelphia, were found filled with crows. Not a caw was to be heard nor a movement seen. The birds appeared to be awaiting in silence further instruction. After some time several new-comers glided among them, threading their way through all the flock, when suddenly the teeming thousands rose simultaneously and departed as mysteriously as they came.

Glacier Theory.—A recently proposed explanation of the annual migration of birds is called the "glacial," and is receiving much attention from ornithologists. It implies that in the so-called "Glacial Period," species now incubating near the present southern limit of perpetual frost, followed the retreat of the ice northward in successive periods, but returning each fall through the influence of habit to their original habitat—successive ages increasing the length of their migration. This theory also presents difficulties, and the problem may be considered as yet unsolved.

HINTS FOR PRESERVING SKINS OF MAMMALS AND BIRDS.

Mammals.—Stuff cotton into the mouth, nostrils, large shot-holes, etc. Split the skin from the top of the breast-bone to the tail, being careful not to cut through the abdominal muscles. Push off the skin, not pull it off from the body. Separate the limbs from the body, preserving all the bones, including the shoulder-blades. With a cleft stick slide out the tail, if covered with hair; but, if naked like the tail of a rat, cut it off, as it can not be skinned. Turn out the legs and clean away all flesh to the toes, leaving the tendons around the joints. Skin over the head, taking off the ears close to the skull, and preserving uninjured the eyelids and lips. Cut into the mouth on the inside of the teeth only to remove the tongue. Cut off the head, cleaning away all muscle and taking out the brain and eyes. While the skin is wrong side out and moist, sprinkle it thoroughly with a mixture of equal parts, by weight, of powdered alum and arsenic. Fill the eye-orbits with cotton. Push the skull and legs back, supplying the place of the flesh in those portions with tow or cotton. Force a wrapped wire into the tail, if skinned, to hold it in place. Leave the skin a few hours, flattened to bring the inner surfaces together, to absorb the mixture. Finally, distend the skin, without stretching it, into its natural shape, as nearly as possible, with any dried vegetable substance.

Birds.—Take the girth of the body over the wings with a slip ot paper, pinning it in the form of a ring, and slide it off over the tail. Begin the incision with the lower third of the breast-bone. Cut off the legs at the knee-joint, and the wings at the elbow-joint. Skin over the head to the bill, pulling out the ears and enlarging the orifice to take out the brain by cutting forward into the roof of the mouth. In all other respects proceed as with Mammals, with such slight modifications as will naturally suggest themselves. Most web-footed birds have the head too large to force the skin over. For these, skin the neck as far as possible, amputate, and after the skin is poisoned and turned back, an incision must be made on the top of the head or under the throat, by which the head may be skinned in the usual way. Then poison, turn back, and carefully sew up the incision. Great care must be taken to work the poison around the roots of the tail and the wrist-bones of the wings, opening orifices on the inside with the blade of the knife, and inserting a pinch of the powder. In the case of very long wings, after turning the skin back, cut a slit along the under-side of the arm and remove the muscles. Stuff cotton loosely into the neck and body and around the bones of the legs. Tie the bones of the wings in their natural position. Sew up the slit, and after a careful arrangement of any displaced feathers, place the bird in the paper ring, and label. Upon the label should be written the scientific and the local name; the length in inches, from tip of beak to tip of tail, the bird lying on its back with neck not stretched; length of wing from carpal joint to tip of longest quill; and of tail from insertion to end; the sex; kind of food found in the stomach; locality; date; and the name of the collector. To remove blood, wash freely with warm water and dry immediately by dusting on finely powdered plaster of Paris or chalk; also sprinkle on the chalk or plaster if fat annoys while skinning. Oily stains may be removed from feathers by a solution of potash or soda (half a teaspoonful to a cup of water), and washing immediately after with pure water and drying with plaster. If the feathers to be cleansed are colored, ox or sheep's gall, diluted one half with water, should be used instead of the potash or soda. Single feathers, permanently bent, may be at once restored to their natural position by simply holding them in a jet of steam issuing from the spout of a tea-kettle. For study, unmounted specimens of birds or animals are always preferred ; and as mounting is a distinct art from simply preserving, and can be learned only from a teacher, no attempt is made to give instructions in it.

Eggs should never be washed, even to remove the filth of the nest. A dentist's tooth-drill or a nail filed three-cornered may be used for drilling a hole in the side. By inserting a small glass tube or straw the contents may be blown out of the same hole, around the tube. Blowing in a little water and shaking thoroughly will often facilitate the process. If the embryo is partly developed, a larger hole may be cut, and the contents removed with a hooked pin, pulling out one limb at a time, and cutting it off. The operation of blowing eggs should always be performed over water. Labels for eggs should note particularly the date, locality, site chosen by the bird, scientific and common name, and any facts of interest.*

HINTS FOR STUDYING THE LOWER VERTEBRATES.

In the latitude of southern New England during fifteen or twenty days after June 10th, the smaller tortoises may be found about sundown on the margins of the ponds and streams digging holes and laying their eggs ; the larger, as *Chel′y dra ser pen ti′ na*, doing the same thing about sunrise in the morning. Removing the eggs carefully without turning them over, they may be placed two or three inches deep in garden sand, protected with net-work, kept moist, and so the progress of embryonic development watched till they hatch in September or October, by examining one egg at a time every two or three weeks.

The development of the Batrachians may be studied in a similar way by transferring frog and toad spawn, found in streams about the first of June, to a glass vessel of water containing sand and pebbles. It will be noticed that frogs' eggs are in a glairy mass ; toads' eggs in a glairy string. If a female newt be placed in the vessel with some growing aquatic plant like spotted knot-weed (*Po lyg′ o num per si ca′ ria*), its curious habit of folding a leaf in which to deposit its egg may be observed, and in time all the changes pertaining to its metamorphosis.

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* Complete material for taxidermical work can be obtained of J. M. Southwick, Providence, R. I.

Large forms may be skinned and preserved according to the directions already given for Mammals and Birds. Small specimens should be kept in alcohol, after making an incision low down on the side, by simply inserting a penknife at as small an angle to the surface as will permit the point to enter the cavity of the abdomen. After a few days, alcoholic specimens should be changed into fresh alcohol at least 80° proof. Glycerine may be substituted for alcohol, when it is desirable to preserve the colors.

HINTS FOR PREPARING LIGAMENTAL SKELETONS OF THE VERTEBRATES.

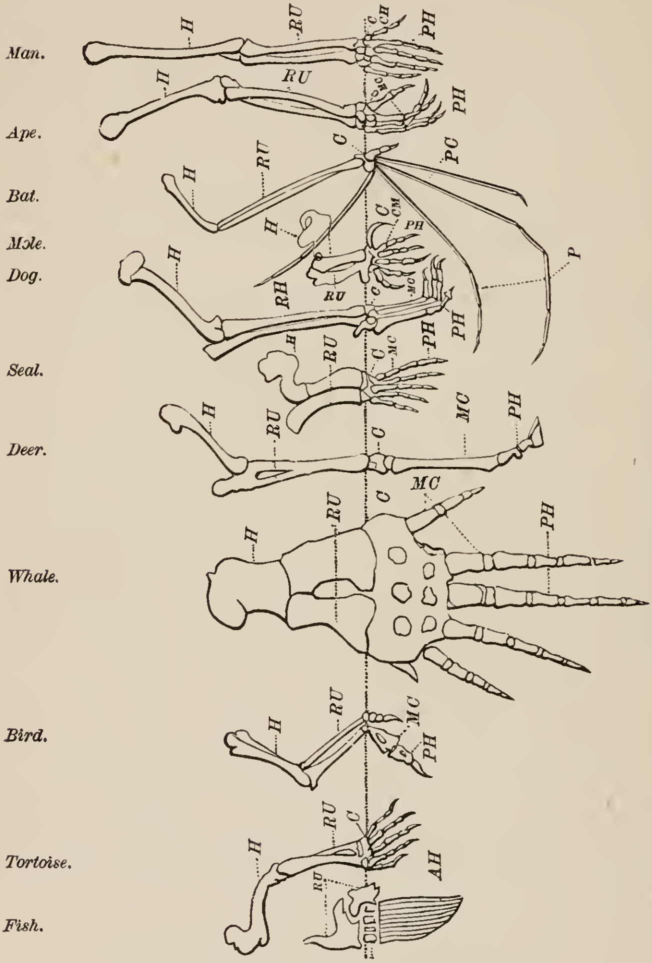
First remove all the muscle that can be conveniently taken off with knife and scissors, but leave the ligaments around the joints. The specimen should next be macerated (soaked) in soft water, with the addition of a little soda of potash, changing the water daily for a week, and then leaving it till the remaining muscle can be scraped off with the finger-nail or a tooth-brush, and the rotted brain be rinsed out with water. At this stage, while the skeleton is held beneath the surface of clean water, all fibers may be snipped off with scissors without injuring the ligaments, and the bones thoroughly cleaned without scraping them with any hard instrument. Next run a wire down the spinal cavity and bend the backbone into any desired position. Finally, hang up the skeleton by threads till dry.

Any animal larger than a fox should be cleaned, in the manner already described, of every thing, even to the ligaments, and the bones wired together. Small skeletons of the size of a rat can be made ready for maceration and then put into a perforated box and placed in an ant-hill. These insects will quickly remove all the flesh, and the skeleton should be taken away as soon as they begin to attack the ligaments, or the ligaments poisoned with corrosive sublimate, while the ants continue their work on the softer parts. Following these general directions, a little experience and a great deal of patience and perseverance will insure success.

HOMOLOGIES OF THE VERTEBRATES.

A comparison of Figs. 367, 378, 422, and 425, illustrating the anatomy of some of the various orders of Mammals, shows a remarkable similarity of structure. Thus, while the figure and size of the head of the mammals vary greatly, it is always composed of the same parts, marked by the same processes and united in the same

Fig. 481.


Man.
Ape.
Bat.
Mole.
Dog.
Seal.
Deer.
Whale.
Bird.
Tortoise.
Fish.
H
RU
C
CH
PH
MC
PC
CM
P
RH
AH

Limbs.—Anterior members of Vertebrata.

H, Humerus. *RU*, Ulna and Radius. *C*, Carpus. *MC*, Metacarpus. *PH*, Phalanges.

order. Any difference is only a modification of form and structure, rather than of omission or addition. These variations are least observable in the embryonic state, and become more apparent in maturity, through the ossifying or non-ossifying of the sutures, the greater or less development of the processes for muscular attachment, and the adaptation of the cranium to the size and shape of the brain. The so-called "facial angle," formed by a line drawn from the forehead to the most prominent part of the upper jaw, and meeting a line from the middle of the ear to the base of the nose, shows the difference in the form of the head, and is an index to the intelligence of the several orders of mammals.

In the skeleton of the horse, a careful study of the angle formed by the scapula and humerus with that formed by the ilium and femur, will show how antagonism in direction gives stability of position. Were both angles directed the same way, the bones would shut together and the animal fall. That there may be a double antagonism and a lower against an upper, the angle formed by the humerus and forearm antagonizes that formed by the femur and leg; but each respectively in the contrary direction to the antagonism immediately above it, thus intensifying the stability.

Comparing the anterior limbs of different orders of mammals with those of birds, reptiles, and fishes (see Fig. 481) the same fundamental idea will be recognized in all, yet so modified as to adapt the several species to the most diversified modes of life. Thus from man to the fish are found the humerus (H), the ulna and radius of the forearm (Ur), the carpal bones (C), the metacarpal (MC), and the phalanges (PH). The greatest modification is observable in the wrist-bones (indicated by the dotted line) and those below. The normal number of carpals, metacarpals, and phalanges, is sometimes reduced and sometimes multiplied, that the limb may be used specifically, according to the wants of the animal, for swimming, crawling, flying, paddling, running, digging, climbing, etc. The perfection of the human hand, which combines nearly all these uses, depends chiefly on the free revolving motion of the humerus and the rotation of the radius about the ulna. This mode of action necessitates a clavicle. The more perfect this bone, the greater the power of rotating the forearm; and, when the clavicle is wanting, the radius and ulna are usually consolidated and the forelimbs become only columns of support or instruments of progression. This latter condition existing in the horse and the ruminants, the metacarpals are greatly elongated, elevating the heel to the height of the knee in other quadrupeds, and permitting the toe only to touch the ground.

The posterior extremities follow the analogies of the anterior in most mammals, the true knee with its patella being more or less concealed in the flanks, with a corresponding elongation of the heel, the toe only touching the ground.

Laws of Comparative Anatomy.—The foregoing remarks upon homologies and analogies prepare for a deduction of some of those great laws of coexistence which lie at the foundation of comparative anatomy.

1. Since the extremities by means of which the animal procures its food must always bear a certain relation to the teeth which masticate and fit it for the stomach, the former decide the animal's external structure, and the latter its internal organization.

2. The position and size of the processes of different bones determine the direction and force of the muscles by which they are worked.

3. The character of the muscles determines the structure of the nerves which call them into action, and of the brain in which the nerves originate.

4. The nervous system determines the degree of intelligence.

The structure of an animal, its natural habit and mode of life, can be deduced from the bones of the extremities, and even from the ends only of any one of them. For instance, the shape of a single finger-bone indicates the necessary form of the one with which it articulates; this latter its fellow, and so on through the series including the metacarpal, carpal, radius and ulna, humerus, scapula and clavicle. The result of this investigation suggests at once to a comparative anatomist the structure of the teeth, whether herbivorous or carnivorous, and thus enables him to decipher the entire character of the animal. Any bone in the series answers equally well for a starting-point, and the skill of the investigator is shown in the readiness with which he reconstructs the whole bony fabric from the extremity furnished. Thus Cuvier, from single bones found in the gypsum near Paris, drew the entire outline of fossil genera of mammals; and Agassiz, from isolated scales, restored the whole fish. (See "Geology," pp. 182 and 203.)

SYSTEMATIC ARRANGEMENT

OF

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ANIMAL KINGDOM.

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
PROTOZOA.	RHIZOPODA.	FORAMINIFERA.	Amœba	proteus,	*Amœba.*
			Arcella	dentatus,	*Crown Amœba.*
			Globigerina	bulloides,	*Globigerina.*
			Nummulites	ataica,	*Rhizopod.*
		RADIOLARIA.	Heliosphœra	echinoides,	*Spiny Radiolarian.*
	INFUSORIA.	FLAGELLATA.	Euglena	viridis,	*Green Euglena.*
			Codosiga	botrytes,	*Clustered Codosiga.*
			Noctiluca	miliaris.	
		CILIATA.	Paramœcium	caudatum,	
			Vorticella	nebulifera,	*Bell Animalcule.*
PORIFERA.	SPONGIA.	CALCISPONGIA	Grantia	ciliata,	*Calcareous Sponge.*
		HYALOSPONGIA	Euplectellum	aspergillum,	*Venus Flower Basket.*
		CERASPONGIA	Euspongia	adriatica.	*Common Sponge.*

CŒLENTERATA.	HYDROZOA.	Hydroidea.	Hydra fusca,	*Common Hydra.*
			Obelia gelatinosa,	*Campanularian Hydroid.*
		Discophora.	Aurelia flavidula,	*Jelly-fish.*
	ACTINOZOA.	Actinoida.	Metridium marginatum,	*Sea Anemone.*
			Ctenactis echinata,	*Mushroom Coral.*
			Thecocyathus cylindraceus,	*Cup Coral.*
		Alcyonaria	Corallium rubrum,	*Red Coral.*
			Gorgonia flabellum,	*Sea-fan.*
			Tubipora musica,	*Organ-pipe Coral.*
ECHINODERMATA.	CRINOIDEA.	Brachiata.	Rhizocrinus loftensis,	*Stone-lily.*
	ASTEROIDEA.	Asteridea.	Asterias forbesii,	*Star-fish.*
			Astrophyton agassissii,	*Basket-fish.*
	ECHINOIDEA.	Cidaridea.	Strongylocentrotus drobachiensis,	*Sea-urchin.*
		Clypeastridea.	Schizaster,	*Sea-otter.*
	HOLOTHUROIDEA.	Apoda.	Synapta girardii,	*Sea-cucumber.*
VERMES.	PLATYHELMINTHES.	Dendrocœla.	Planaria torva,	*Planarian Worm.*
		Trematoda.	Distoma hepaticum,	*Liver Fluke.*
		Cestoda.	Tænia solium,	*Tape-worm.*
	NEMATHELMINTHES.	Nematoda.	Leptodera oxophila,	*Vinegar Eel.*
			Trichina spiralis,	*Muscle-worm.*
			Gardius aquaticus,	*Hair-worm.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
VERMES.	ANNELIDA.	Oligochæta.	Lumbricus	terrestris,	*Earth-worm.*
		Polychæta.	Nereis	pelagica,	*Clam-worm.*
			Autolytus	cornutus.	
		Discophori.	Hirudo	medicinalis,	*Medicinal Leech.*
MOLLUSCOIDEA.	POLYZOA.		Paludicella	ehrenbergii.	
	BRACHIOPODA.		Terebratulina	septentrionalis,	*Lamp-shell.*
			Lingula	pyramidata,	*Tongue-shell.*
LUSCA.	ACEPHALA.	Asiphonia.	Ostræa	virginiana,	*Common Oyster.*
			Pecten	irradians,	*Scallop-shell.*
			Meleagrina	margaritifera,	*Pearl-oyster.*
			Malleus	vulgaris,	*Hammer-oyster.*
			Mytilus	edulis,	*Mussel.*
			Unio	complanatus,	*Fresh-water Clam.*
			Mya	arenaria,	*Salt-water Clam.*
			Solen	ensis,	*Razor-clam.*
			Teredo	navalis,	*Ship-worm.*
	CEPHALOPHORA.	Scaphopoda.	Dentalium	dentalis,	*Tooth-shell.*
		Polyplacophora.	Chiton	elegans,	*Chiton.*
		Nudibranchiata.	Doris	pilosa,	*Doris-shell.*
		Pulmonata.	Helix	albolabris,	*Land-snail.*
			Limax	campestris,	*Slug.*

MOL		ZYGOBRANCHIA.	Fissurella listeri,	*Key-hole Limpet.*
			Haliotis abalome,	*Ear-shell.*
			Cypræa tigris,	*Cowry-shell.*
	CEPHALOPODA.	TETRABRANCHIATA.	Nautilus pompilius,	*Pearly Nautilus.*
		DIBRANCHIATA.	Argonauta argo,	*Paper Argonaut.*
			Octopus vulgaris,	*Poulp.*
			Loligo pealeii,	*Cuttle-fish.*
			Loligo bartramii,	*Squid.*
ARTHROPODA.	CRUSTACEA.	COPEPODA.	Cyclops communis,	*Cyclops.*
		SIPHONOSTOMATA.	Lernœonéma radiata,	*Fish-louse.*
		PHYLLOPODA.	Branchipus vernalis,	*Fresh-water Shrimp.*
			Lepidurus couesii,	*Coues' Shrimp.*
		CIRREPEDIA.	Balanus balanoides,	*Acorn Barnacle.*
			Lepas anatifera,	*Goose Barnacle.*
		ISOPODA.	Porcellio,	*Pill-bug.*
		AMPHIPODA.	Orchestia agilis,	*Beach-flea.*
		DECAPODA.	Astacus fluviatilis,	*River-lobster.*
			Eupagurus bernhardus,	*Hermit-crab.*
		MEROSTOMATA.	Limulus polyphemus,	*Horse-shoe Crab.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
OPODA.	ARACHNIDA.	ACARINA.	Sarcoptes	scabiei,	*Itch-mite.*
			Ixodes	bovis,	*Cattle-tick.*
		PEDIPALPI.	Buthus	carolinianus,	*Scorpion.*
			Phalangium	dorsatum,	*Daddy-long-legs.*
		ARANEIDA.	Epeira	diadema,	*Geometrical Spider.*
			Mygale	hentzii,	*Trap-door Spider.*
	MYRIAPODA.	DIPLOPODA.	Julus	canadensis,	*Thousand-legs.*
		CHILOPODA.	Scolopendra	gigantea,	*Centipede.*
	HEXAPODA.	THYSANURA.	Lepisma	saccharina,	*Spring-tail.*
		DERMATOPTERA.	Forficula	auricularia,	*Earwig.*
		PSEUDONEUROPTERA.	Termes	lucifugus,	*White Ant.*
			Libellula	depressa,	*Dragon-fly.*
			Ephemera	vulgata,	*May-fly.*
		NEUROPTERA.	Limnophilus	rhombicus,	*Caddis-worm.*
			Myrmeleon	formicarius,	*Ant-lion.*
		ORTHOPTERA.	Blatta	orientalis,	*Cockroach.*
			Cyrtophyllus	concavus,	*Katydid.*
			Conocephalus	ensiger,	*Grasshopper.*
			Caloptenus	spretus,	*Rocky Mountain Locust.*
		HEMIPTERA.	Cicada	septendecim,	*Seventeen-year Cicada.*
			Aphis	rosæ,	*Plant-louse.*
			Eriosoma	lanigera,	*Apple-blight Insect.*

ARTHR	COLEOPTERA.	Doryphora decem-lineata,	*Colorado Beetle.*
		Scolytus destructor,	*Bark-borer.*
		Balaninus nucum,	*Weevil.*
		Lachnosterna fusca,	*June-bug.*
		Anthrenus scrophulariæ,	*Carpet Beetle.*
	DIPTERA.	Cecidomyia destructor,	*Hessian Fly.*
		Culex pipiens,	*Mosquito.*
		Musca domestica,	*House-fly.*
	APHANIPTERA.	Pulex irritans,	*Human Flea.*
	LEPIDOPTERA.	Tinea pellionella,	*Clothes Moth.*
		Clisiocampa americana,	*Tent Caterpillar.*
		Bombyx mori,	*Silk-worm.*
		Pieris oleracea,	*Cabbage Butterfly.*
	HYMENOPTERA.	Nematus ventricosus,	*Saw-fly.*
		Cynips quercusfolii,	*Gall-fly.*
		Ichneumon manifestator,	*Ichneumon-fly.*
		Ponera grandis,	*Giant Ant.*
		Formica sanguinea,	*Red Ant.*
		Myrmecia forficata.	
		Mutilla cephalotos.	
		Sphex ichneumea,	*Digger Wasp.*
		Vespa maculata,	*Hornet.*
		Bombus pratorum,	*Bumble-bee.*
		Apis mellifica,	*Honey-bee.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
BRATA.	ACRANIA.		Branchiostoma	lanceolatum,	*Amphioxus.*
	CYCLOSTOMA.	HYPEROARTIA.	Petromyzon	marinus,	*Lamprey.*
	ELASMOBRANCHII.	SQUALI.	Sphyrna	zygænus,	*Hammer-head Shark.*
		RAJII.	Dasybatis	centrurus,	*Sting-ray.*
			Pristis	antiquorum,	*Saw-fish.*
	GANOIDEI.	CHONDROSTEI.	Acipenser	sturio,	*Sturgeon.*
		GINGLMODI.	Lepidosteus	osseus,	*Gar-pike.*
		HALECOMORPHI.	Amia	calva,	*Mud-fish.*
	TELEOSTEI.	APODES.	Anguilla	vulgaris,	*Broad-nosed Eel.*
			Silurus	glanis,	*Sly Silurus.*
		NEMATOGNATHI.	Pimelodus	atrarius,	*Cat-fish.*
		EVENTOGNATHI.	Carassius	auratus,	*Gold-fish.*
		ISOSPONDYLI.	Clupea	vernalis,	*Herring.*
			Salmo	salar,	*Salmon.*
		HAPLOMI.	Esox	reticulatus,	*Pickerel.*
		SYNENTOGNATHI.	Exacœtus	volitans,	*Flying-fish.*

VERTE		ALANTHOPTERYGII.	Blepharis crinitus,	*Cobbler-fish.*
			Xiphias gladius,	*Sword-fish.*
			Toxotes jaculator,	*Archer.*
			Perca americana,	*Yellow Perch.*
		ANACANTHANI.	Morrhua americana,	*Cod.*
		HETEROSOMATA.	Echeneis remora,	*Suck-fish.*
		DISCOCEPHALI.	Pleuronectes platessa,	*Flat-fish.*
		LOPHOBRANCHII.	Syngnathus peckianus,	*Pipe-fish.*
		GYMNODONTES.	Cirrhosomus turgidus,	*Swell-fish.*
		PEDICULATI.	Lophius americanus,	*Fishing-frog.*
	DIPNOI.	MONOPNEUMONIA.	Ceratodus forsteri,	*Barramunda.*
	BATRACHIA.	URODELA.	Proteus anguinus,	*Proteus.*
			Necturus maculatus,	*Menobranchus.*
			Siren lacertina,	*Siren.*
			Salamandra maculosa,	*Spotted Salamander.*
			Diemyctylus viridescens,	*Newt, or Triton.*
		ANURA.	Pipa americana,	*Surinam Toad.*
			Bufo americanus,	*Common Toad.*
			Rana catesbiana,	*Bull-frog.*
			Hyla versicolor,	*Tree-frog.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
Continued.	REPTILIA.	OPHIDIA.	Eutenia	sirtalis,	*Striped Snake.*
			Boa	anaconda,	*Anaconda.*
			Elaps	corallina,	*Coral Snake.*
			………………	………………	*Cobra-da-capello.*
			………………	………………	*Sea-snake.*
			Crotalus	horridus,	*Rattlesnake.*
			Ancistrodon	contortrix,	*Copper-head.*
			Ancistrodon	piscivorous,	*Water-moccasin.*
		LACERTILIA.	Iguana	tuberculata,	*Iguana.*
			Heloderma	horrida,	*Gila Monster.*
			Anolis	principalis,	*Southern Chameleon.*
			Phrynosoma	cornuta,	*Horned Toad.*
			Ophisaurus	ventralis,	*Glass Snake.*
			Eumeces	fasciatus,	*Blue-tailed Skink.*
			Chameleon	vulgaris,	*Chameleon.*
		CHELONIA.	Chelonia	mydas,	*Green Turtle.*
			Eretmochelys	imbricata,	*Hawk-billed Turtle.*
			Aspidonectes	ferox,	*Soft-shelled Turtle.*
			Cistudo	virginiana,	*Box Tortoise.*
			Chelydra	serpentina,	*Snapping Turtle.*
		CROCODILIA.	Gavialis	gangeticus,	*Gavial.*
			Crocodilus	vulgaris,	*Crocodile.*
			Alligator	mississippiensis,	*Alligator.*

VERTEBRATA.	AVES.	STRUTHIONES.	Struthio camelus,	*African Ostrich.*
			Rhea rhea,	*South American Ostrich.*
		APTERYGES.	Apteryx mantelli,	*Apteryx.*
		CRYPTURI.	Tinamus brasiliensis,	*Tinamou.*
		SPHENISCI.	Spheniscus demersus,	*Penguin.*
		PYGOPODES.	Fratercula arctica,	*Puffin.*
			Podiceps cornutus,	*Grebe, or Dobchick.*
			Colymbus torquatus,	*Loon.*
		LONGIPENNES.	Diomedea exulans,	*Albatross.*
			Thalassidroma pelagica,	*Stormy Petrel.*
			Rhynchops nigra,	*Scissors-bill.*
			Sterna wilsoni,	*Wilson's Tern.*
			Stercorarius parasiticus,	*Hectic Skua.*
			Larus marinus,	*Great Black-backed Gull.*
		STEGANOPODES.	Plotus anhinga,	*Snake-bird.*
			Pelecanus fuscus,	*Brown Pelican.*
			Pelecanus erythrorhyncus,	*White Pelican.*
			Graculus carbo,	*Cormorant.*

BRANCH.	CLASS.	ORDER.	GENUS. SPECIES.	EXAMPLES.
Continued.	AVES.	LAMELLIROSTRES.	Mergus americanus,	*Goosander.*
			Somateria mollissima,	*Eider-duck.*
			Aix sponsa,	*Wood-duck.*
			Bernicla canadensis,	*Wild Goose.*
			Cygnus buccinator,	*Trumpeter-swan.*
			Cygnus americanus,	*Whistling Swan.*
			Phœnicopterus ruber,	*Flamingo.*
		ALECTORIDES.	Grus americanus,	*Whooping Crane.*
			Rallus virginianus,	*Virginia Rail.*
			Ionornis martinica,	*Purple Gallinule.*
			Fulica americana,	*Coot.*
		HERODIONES.	Tantalus loculator,	*Wood Ibis.*
			Ardea herodias,	*Great Blue Heron.*
			Ajaja ajaja,	*Roseate Spoonbill.*
			Ciconia alba,	*White Stork.*
		LIMICOLÆ.	Philohela minor,	*Woodcock.*
			Recurvirostra americana,	*Avocet.*
			Hæmatopus palliatus,	*Oyster-catcher.*
			Charadrius virginicus,	*Golden Plover.*
			Ortyx virginianus,	*Bob-white.*
			Bonasa umbellus,	*Ruffed Grouse.*

VERTEBRATA,	GALLINÆ.	Cupido cupidonia,	*Pinnated Grouse.*
		Coturnix communis,	*True Quail.*
		Meleagris ocellata,	*Honduras Turkey.*
		Meleagris gallopavo,	*Wild Turkey.*
		Meleagris mexicana,	*Mexican Turkey.*
		Numida meleagris,	*Guinea-fowl.*
		Pavo cristatus,	*Peacock.*
		Argus giganteus,	*Argus Pheasant.*
	COLUMBÆ.	Ectopistes migratoria,	*Passenger-pigeon.*
		Columba livia,	*Rock-dove.*
	RAPTORES.	Rhynogryphus aura,	*Turkey Buzzard.*
		Pseudogryphus californianus,	*California Vulture.*
		Catharista atrata,	*Black Vulture.*
		Sarcorhamphus gryphus,	*Condor.*
		Haliaëtus leucocephalus,	*White-headed Eagle.*
		Nauclerus furcatus,	*Swallow-tailed Hawk.*
		Polyborus tharus,	*Caracara Eagle.*
		Astur atricapillus,	*Goshawk.*
		Falco sparverius,	*Sparrow-hawk.*
		Bubo virginianus,	*Great-horned Owl.*
	PSITTACI.	Conurus carolinensis,	*Carolina Parrot.*
		Cacatua sulphurea,	*Sulphur-crested Cockatoo.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
Continued.	AVES.	PICARIÆ.	Picoides	hirsutus,	*Tree-toed Woodpecker.*
			Colaptes	auratus,	*Golden-winged Woodpecker.*
			Camphephilus	principalis,	*Ivory-billed Woodpecker.*
			Ramphastos	tucanus,	*Toucan.*
			Coccygus	americanus,	*Yellow-billed Cuckoo.*
			Coccygus	erythrophthalmus,	*Black-billed Cuckoo.*
			Geococcyx	californianus,	*Road Runner.*
			Trochilus	colubris,	*Ruby-throated Humming-bird.*
			Chætura	pelasgia,	*Chimney-swallow.*
			Calurus	resplendens,	*Resplendent Calurus.*
			Chordeiles	popetue,	*Night-hawk.*
			Antrostomus	vociferus,	*Whip-poor-will.*
			Ceryle	alcyon,	*Belted King-fisher.*
			Myiarchus	crinitus,	*Great-crested Fly-catcher.*
			Menura	superba,	*Lyre-bird.*
			Paradisea	apoda,	*Paradise Bird.*
			Ploceus	socius,	*Weaver-bird.*
			Molothrus	pecoris,	*Cow-bird.*
			Corvus	corax,	*Raven.*
			Cyanura	cristata,	*Blue Jay.*
			Icterus	baltimore,	*Baltimore Oriole.*
			Dolichonyx	orizyvorous,	*Bobolink.*
			Eremophila	cornuta,	*Shore-lark.*

VERTEBRATA.		PASSERES.	Curvirostra leucoptera,	*White-winged Cross-bill.*
			Curvirostra americana,	*Cross-bill.*
			Melospiza melodia,	*Song-sparrow.*
			Pyranga rubra,	*Scarlet Tanager.*
			Collurio borealis,	*Butcher-bird.*
			Ampelis cedrorum,	*Cedar-bird.*
			Hirundo horreorum,	*Barn-swallow.*
			Hirundo bicolor,	*Two-colored Swallow.*
			Philomela luscinia,	*Nightingale.*
			Sialia sialis,	*Blue-bird.*
			Erythacus rubecula,	*Robin-redbreast.*
			Mimus polyglottus,	*Mocking-bird.*
			Turdus migratorius,	*Robin.*
	MAMMALIA.	MONOTREMATA.	Ornithorhynchus anatinus,	*Duck-bill.*
			Echidna hystrix,	*Porcupine Ant-eater.*
		MARSUPIALIA.	Didelphys virginiana,	*Opossum.*
			Macropus major,	*Kangaroo.*
		EDENTATA.	Dasypus novemcinctus,	*Nine-banded Armadillo.*
			Tolypeutis tricinctus,	*Three-banded Armadillo.*
			Chlamyphorus truncatus,	*Pichiciago.*
			Bradypus tridactylus,	*Three-toed Sloth.*
			Myrmecophaga jubata,	*Giant Ant-eater.*
			Manis longicauda,	*Long-tailed Pangolin.*

BRANCH.	CLASS.	ORDER.	GENUS.	SPECIES.	EXAMPLES.
Continued.		RODENTIA.	Lepus	americanus,	*Northern Hare.*
			Lepus	sylvaticus,	*Gray Rabbit.*
			Lepus	campestris,	*Jack Rabbit.*
			Cavia	cobaya,	*Guinea-pig.*
			Hystrix	cristata,	*Porcupine.*
			Zapus	hudsonius,	*Jumping-mouse.*
			Geomys	bursarius,	*Pouched Gopher.*
			Arvicola	viparia,	*Meadow-mouse.*
			Hesperomys	leucopus,	*White-footed Mouse.*
			Mus	musculus,	*House-mouse.*
			Mus	decumanus,	*House-rat.*
			Fiber	zibethicus,	*Musk-rat.*
			Castor	canadensis,	*American Beaver.*
			Cynomys	ludovicianus,	*Prairie-dog.*
			Spermophilus	tridecem lineatus,	*Thirteen-lined Squirrel.*
			Tamias	striatus,	*Chipmunk.*
			Sciurus	carolinensis,	*Gray Squirrel.*
			Sciurus	vulpinus,	*Southern Fox Squirrel.*
			Sciuropterus	volucella,	*Flying-squirrel.*
			Erinaceus	europæus,	*Hedgehog.*
			Sorex	Thompsoni,	*Thompson's Shrew.*
			Scalops	aquaticus,	*Common Mole.*
			Condylura	cristata,	*Star-nosed Mole.*
			Galeopithecus	volans,	*Colugo.*
			Plecatus	macrotis,	*Big-eared Bat.*

VERTEBRATA,	MAMMALIA.	INSECTIVORA.	Atalapha noveboracensis,	*Red Bat.*
			Atalapha cinerea,	*Hoary Bat.*
			Vespertilio subulatus,	*Little Brown Bat.*
			Vespertilio,	*Silver Black Bat.*
			Vespertilio,	*Dusky Bat.*
			Pteropus edulis,	*Indian Fruit Bat.*
			Phyllostoma spectrum,	*Vampire.*
		CETACEA.	Beluga canadensis,	*White Whale.*
			Delphinus delphis,	*Dolphin.*
			Monodon monoceros,	*Narwhal.*
			Phocæna communis,	*Common Porpoise.*
			Physeter macrocephalus,	*Sperm-whale.*
			Balæna mysticetus,	*Right-whale.*
		SIRENIA.	Trichecus manatus,	*Manatee.*
			Halicore australis,	*Dugong.*
		PROBOSCIDEA.	Elephas africanus,	*African Elephant.*
			Elephas indicus,	*Asiatic Elephant.*
		UNGULATA.	Tapirus americanus,	*South American Tapir.*
			Tapirus bicolor,	*Indian Tapir.*
			Rhinoceros unicornis,	*One-horned Rhinoceros.*
			Rhinoceros bicornis,	*Two-horned Rhinoceros.*
			Hyrax syriacus,	*Daman.*
			Equus caballus,	*Horse.*

BRANCH.	CLASS.	ORDER.	GENUS. SPECIES.	EXAMPLES.
Continued.		UNGULATA.	Equus asinus,	*Wild Ass.*
			Equus zebra,	*Zebra.*
			Dicotyles torquatus,	*Collared Peccary.*
			Dicotyles labiatus,	*White-lipped Peccary.*
			Sus scrofa,	*Wild Boar.*
			Sus babirusa,	*Babirusa Hog.*
			Hippopotamus amphibius,	*Hippopotamus.*
			Camelus dromedarius,	*Dromedary.*
			Camelus bactrianus,	*Bactrian Camel.*
			Auchenia llama,	*Llama.*
			Cervus dama,	*Fallow Deer.*
			Cervus virginianus,	*Virginia Deer.*
			Cervus capreolus,	*Roebuck.*
			Cervus canadensis,	*Wapiti.*
			Rangifer tarandus,	*Reindeer.*
			Rangifer caribou,	*Caribou.*
			Alces malchis,	*Moose.*
			Moschus moschiferus,	*Musk-deer.*
			Camelopardalis giraffa,	*Giraffe.*
			Bos taurus,	*Domestic Ox*
			Bos americanus,	*Bison.*
			Bos bubalus,	*Buffalo.*
			Bos grunniens,	*Yak.*
			Bos indicus,	*Zebu.*
			Antilope rupicapra,	*Chamois.*

VERTEBRATA,	MAMMALIA.		Antilope dorcas,	*Gazelle.*
			Antilope kudu,	*Koodoo.*
			Antilope gnu,	*Gnu.*
			Antilope oryx,	*Gemsbok.*
			Antilocapra americana,	*Prong-horn.*
			Aplocerus montanus,	*Mountain Goat.*
			Ovis montana,	*Mountain Sheep*
			Ovis aries,	*Domestic Sheep*
			Capra ibex,	*Ibex.*
			Capra ægagrus,	*Goat.*
			Ovibos moschatus,	*Musk-ox.*
		CARNIVORA.	Bassaris astuta,	*Raccoon-fox.*
			Procyon lotor,	*Common Coon.*
			Ursus americanus,	*Black Bear.*
			Ursus horribilis,	*Grizzly Bea*
			Ursus maritimus,	*White Bear*
			Lutra canadensis,	*Otter.*
			Mephitis mephitica,	*Skunk.*
			Taxidea americana,	*Badger.*
			Gulo luscus,	*Wolverine.*
			Putorius lutreolus,	*Mink.*
			Putorius ermineus,	*Weasel.*
			Mustela pennantii,	*Fisher.*
			Mustela americana,	*Sable.*
			Canis lupus,	*Wolf.*

BRANCH.	CLASS.	ORDER.	GENUS. SPECIES.	EXAMPLES.
Continued.	MAMMALIA.	CARNIVORA.	Canis familiaris,	*Mastiff.*
			Canis aureus,	*Jackal.*
			Vulpes vulgaris,	*Fox.*
			Hyena vulgaris,	*Hyena.*
			Viverra civetta,	*Civet.*
			Genetta vulgaris,	*Genet.*
			Herpestes ichneumon,	*Pharaoh's Rat.*
			Felis tigris,	*Tiger.*
			Felis leo,	*Lion.*
			Felis leopardus,	*Leopard.*
			Felis concolor,	*Puma.*
			Felis onça,	*Jaguar.*
			Felis domestica,	*Domestic Cat.*
			Lynx rufus,	*Wild Cat.*
			Lynx canadensis,	*Canada Lynx.*
			Odobænus rosmarus,	*North Atlantic Walrus.*
			Rosmarus obesus,	*North Pacific Walrus.*
			Callorhinus ursinus,	*Fur Seal.*
			Eumetopias stelleri,	*Sea-lion.*
			Phoca vitulina,	*Common Hair Seal.*
			Cheiromys madagascariensis,	*Aye-aye.*
			Tarsius spectrum,	*Specter.*
			Loris gracilis,	*Graceful Loris.*
			Lemur macaco,	*Ruffled Lemur.*

VERTEBRATA.	QUADRUMANA.	Hapale jacchus,	*Marmoset.*
		Pithecia satanus,	*Black Saki.*
		Mycetes ursinus,	*Bear Howler.*
		Ateles pentadactylus,	*Spider Monkey.*
		Cynocephalus mormon,	*Mandrill.*
		Macacus rhesus,	*Rhesus Monkey.*
		Inuus sylvanus,	*Barbary Ape.*
		Semnopithecus nasica,	*Proboscis Monkey.*
		Semnopithecus entellus,	*Sacred Monkey.*
		Hylobates syndactylus,	*Siamang.*
		Hylobates agilis,	*Gibbon.*
		Troglodytes niger,	*Chimpanzee.*
		Troglodytes gorilla,	*Gorilla.*
	BIMANA.	Homo sapiens,	*Man.*

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